E·TECH

y ELECTRONIC INDUSTRIES

ECOMMUNICATIONS • RADIO

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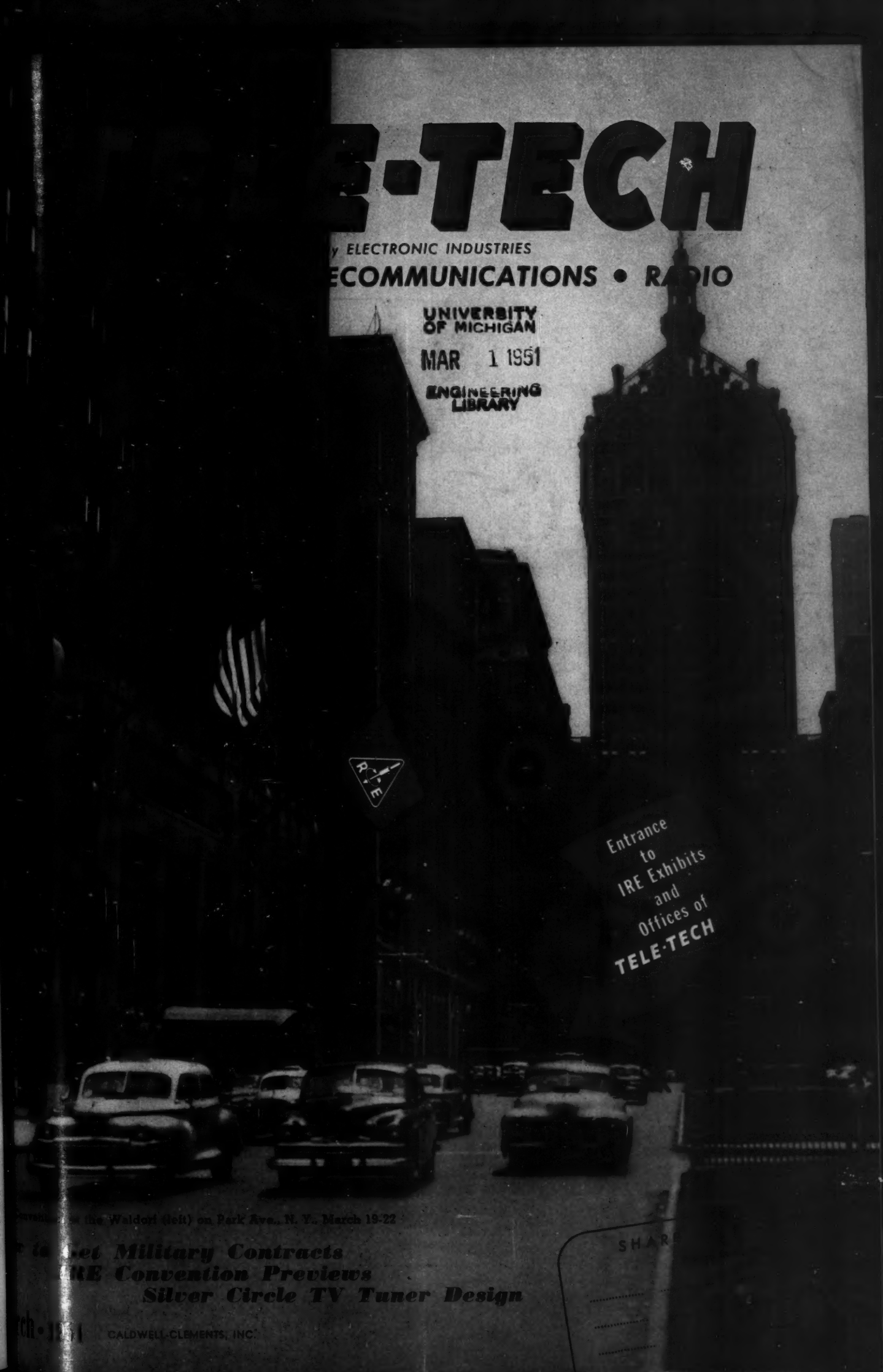


Entrance to IRE Exhibits and Offices of TELE·TECH

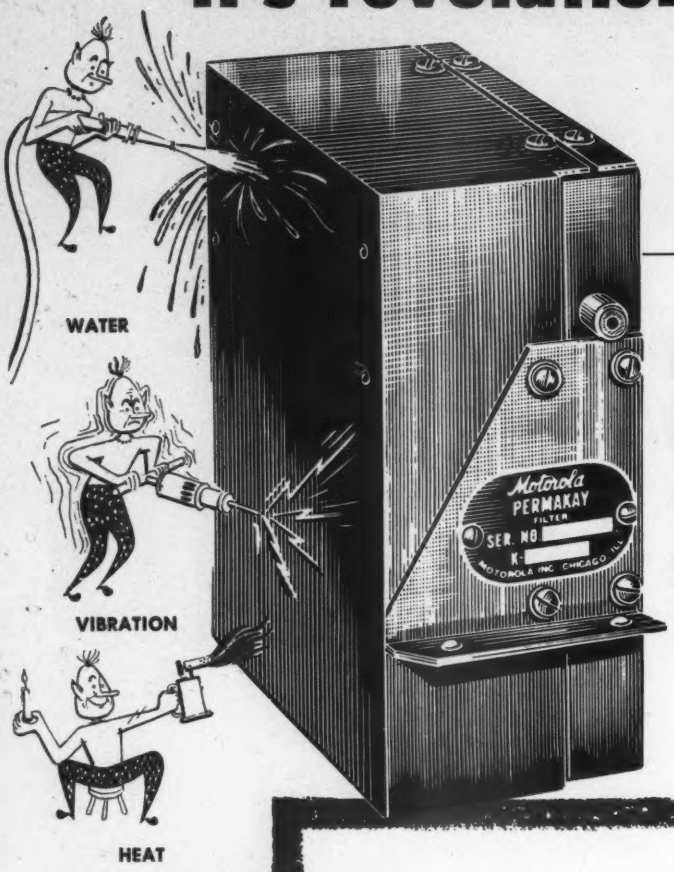
the Waldorf (left) on Park Ave., N. Y., March 19-22

et Military Contracts
RE Convention Previews
Silver Circle TV Tuner Design

SHAR

CALDWELL-CLEMENTS, INC.

it's revolutionizing 2-way radio



it's permanent!

Motorola's amazing invention . . . THE SENSICON PERMAKAY FILTER FOR GUARANTEED PERMANENT SELECTIVITY! *Thousands in the field, operating year in and year out, without failure.*

Permakay is here to stay as the keystone of the Sensicon Circuit

The Permakay I.F. Wave Filter for PERMANENT SELECTIVITY—*guaranteed for the life of the set!* This coil and capacitor filter network is noise-balanced for optimum signal-to-noise ratio, achieved by counterphasing. These super-precision elements are cast in solid waterproof plastic which will not melt, crack, loosen, or deteriorate. PERMAKAY thus assures *permanent* precision selectivity, reduces maintenance, and increases all-around serviceability of your Motorola equipment.

. . . AND HERE AGAIN THE *MOTOROLA GUARANTEE* provides perfect radio service today and protects against obsolescence tomorrow. When radio channels are split you need not buy a new receiver — simply exchange the standard-channel Permakay filter for a new split-channel filter and your receiver is up to date and ready for years of service.

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SPLIT CHANNEL

SENSICON CIRCUIT

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differential squelch

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special types
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...CTIFIERS, TIMERS, COUNTERS,
ETC. FOR
...ORATORY • INDUSTRIAL USE
ATOMIC CONTROL

Operation

...allation, operation and main-
...nance of telecommunications
...equipment in the fields of

...ADCASTING • RECORDING
...IO & SOUND • MUNICIPAL
MOBILE • AVIATION
...MMERCIAL • GOVERNMENT

MARCH, 1951

COVER: IRE's 1951 Convention Hotel, the Waldorf-Astoria, looking south along New York's Park Avenue to the west entrance to Grand Central Palace where, as in past years, the IRE Exhibits will be located. On the sixth floor of the Palace (480 Lexington Ave.) are the offices of Caldwell-Clements, Inc., publishers of TELE-TECH. March 19 to 22 are scheduled dates for IRE Convention and Exhibits.

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"Some Have Greatness Thrust Upon Them"

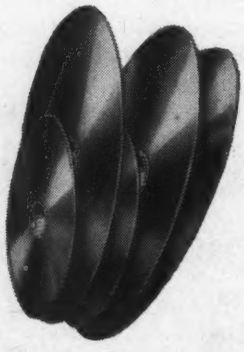
—*Shakespeare*

THE reputation the Reeves Soundcraft name enjoys in the sound recording field has been merited over the years by producing superior, precision products at prices consistent with their quality. The magnetic tape from the Reeves Soundcraft Laboratories offers you *ten* distinct features that assure higher efficiency and fidelity. Our line of recording discs is assorted and designed to answer *every* recording requirement.

You can buy, use and recommend Reeves Soundcraft recording tape and discs with confidence for these products are backed by a reputation we value highly.

Soundcraft tape is made in all types and lengths for use in all tape recorders.

Soundcraft recording discs are available in a variety of sizes, single and double face.



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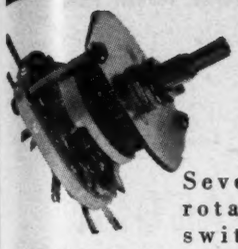
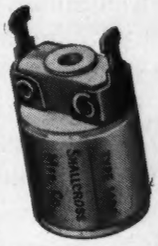
Something New



NEW OVAL SELECTOR SWITCHES

Several new oval rotary selector switches are described in Bulletin L13 just issued by the Shallcross Manufacturing Co., Collingdale, Pa. Six basic plates and three rotor types produce switches having from one to three poles per deck or gang and with other desired mechanical and electrical details. As many as 18, 9 or 6 positions may be obtained in single-, double-, or triple-pole types respectively. These may be single-, double-, or triple-pole decks exclusively or a combination of different types.

VERTICAL STYLE PRECISION RESISTORS FOR JAN USES



Improved vertical style precision wire - wound resistors for use where mounting requirements make it desirable to have both terminals at the same end of the resistor have been introduced by the Shallcross Manufacturing Co., Collingdale, Pa. These units provide a longer leakage path from the mounting screws to the terminals. Known as Shallcross Types BX120, BX140, and BX160, they are designed to meet JAN requirements for styles RB40B, RB41B and RB42B respectively. For commercial uses, the resistors carry somewhat higher ratings than for JAN applications. Wire leads instead of terminals can be furnished if desired. Complete details will glady be sent on request to the manufacturer.

FLAT, METAL-ENCASED WIRE-WOUND RESISTORS

Flat, metal-encased, Type 265A wire-wound power resistors introduced by the Shallcross Manufacturing Company, Collingdale, Penna., are space wound, have mica insulation, and are encased in aluminum for mounting flat against a metal chassis. At 175° C. continuous use they are conservatively rated for 7½ watts in still air and 15 watts when mounted on a metal chassis. Write for Bulletin 122.—*Adv.*

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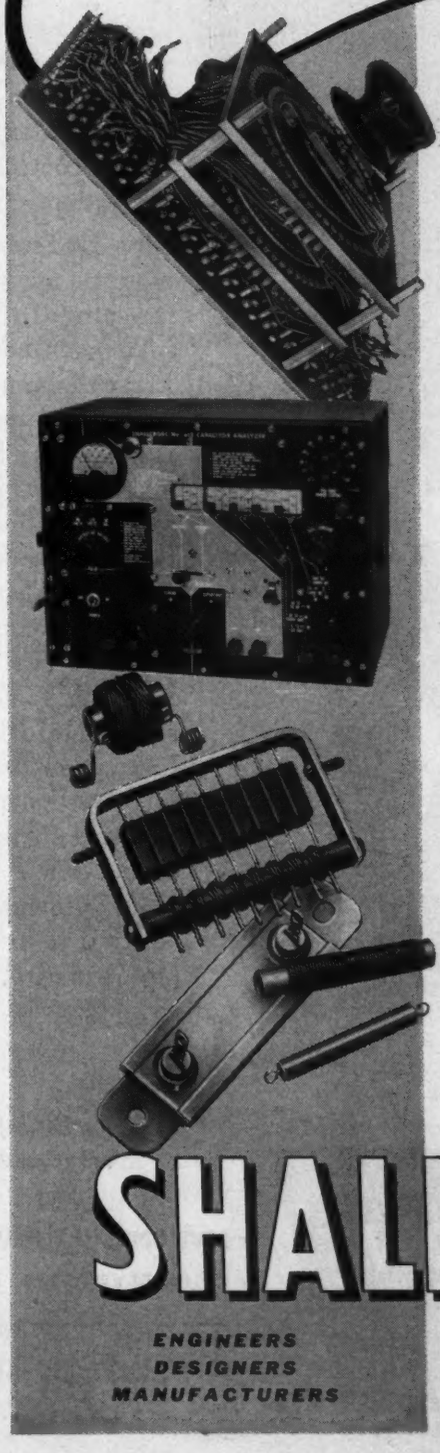
Custom Built

Electric-Electronic Specialties



Leading equipment manufacturers find that it pays to turn specialized assignments over to Shallcross for development, design or production...

From critical components to sub-assemblies and instruments, Shallcross' broad experience and precision facilities assure better results...

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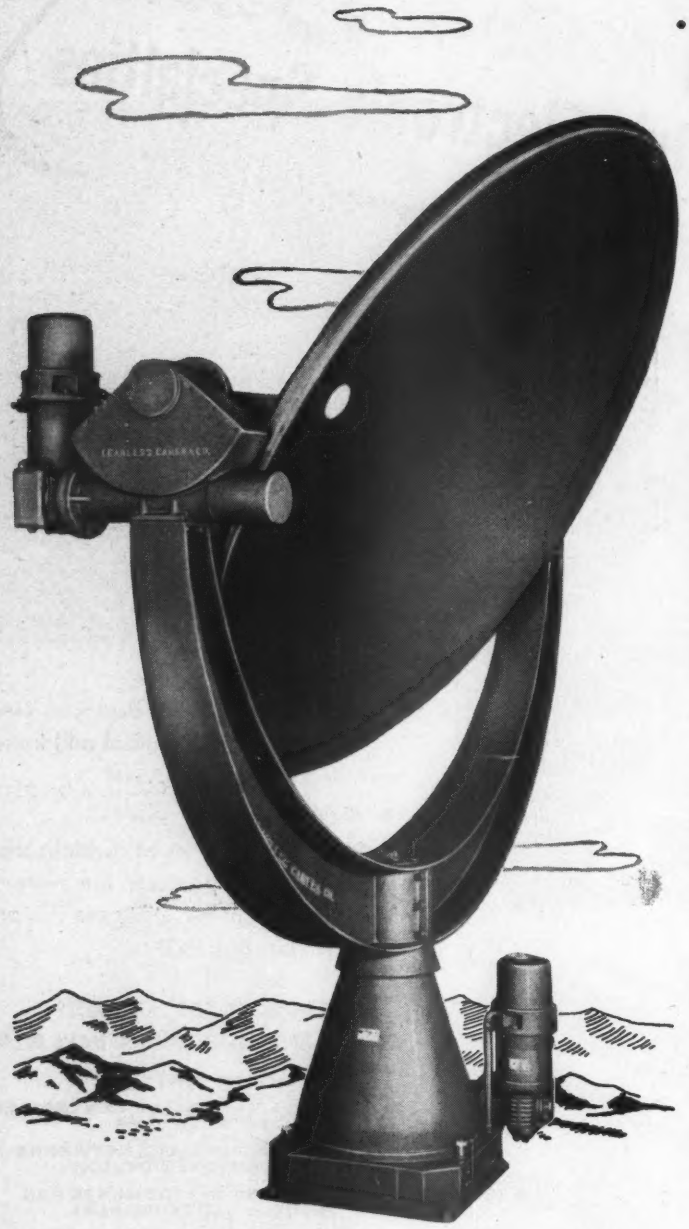


...this new Houston-Fearless

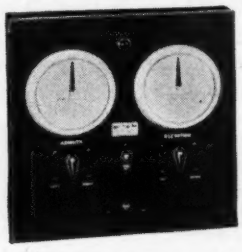
MICROWAVE PARABOLA

operates completely by

REMOTE CONTROL!

There's no need to climb an icy tower in zero weather, wind or rain to position this new Houston-Fearless Remote Control Microwave Parabola. It's all done from the remote control panel (shown below) right in the station.

This Houston-Fearless Parabola can be mounted anywhere within 1500 ft. (or more, if required) of the transmitter. It rotates 370° in azimuth and tilts 15° up and 30° down. Large dials on the remote control panel, calibrated in degrees, show the exact position. It is driven by 1/6 HP motors producing a torque of 10,500 inch pounds @ 1 RPM, sufficient to operate under severe icing conditions. Magnetic brakes prevent overide when Parabola is stopped at any exact position. Designed to operate in the open without protection, it will withstand a wind velocity of 120 mph. Motors and rotating shafts run on sealed, anti-friction bearings and require no lubrication during the life of the unit. Here is complete dependability and freedom from servicing where it really counts. Write for complete information, or contact your R.C.A. representative.



Write for information on specially-built equipment for your specific needs.

The HOUSTON FEARLESS Corporation

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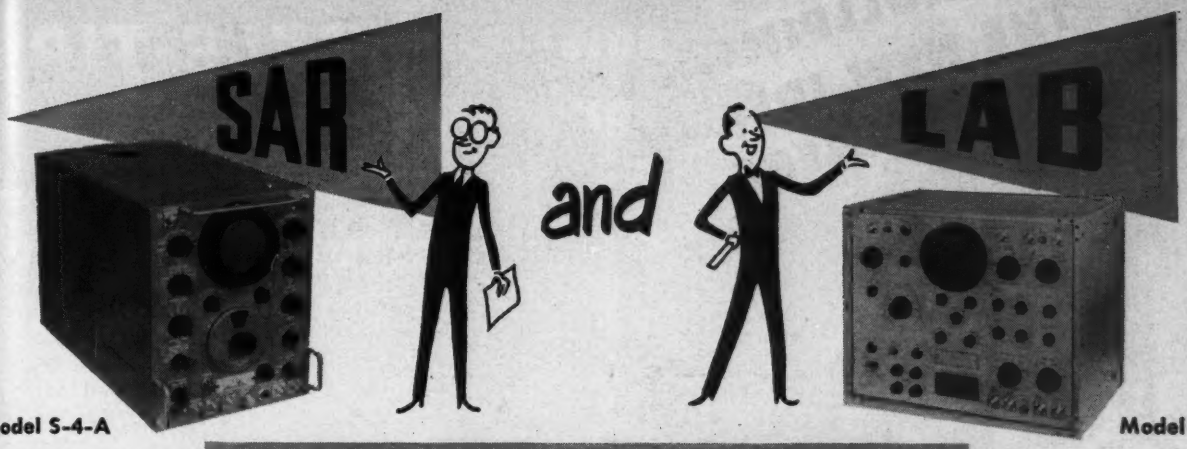


Model S-4-A

Model S-5-A

WATERMAN PIONEERING

WATERMAN INTRODUCES

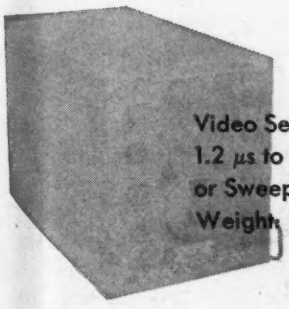
TWO NEW CATHODE RAY OSCILLOSCOPES

Compact, Portable Instruments For Precision Pulse Measurement Adaptable To All Electronic Work, Including TV . . .

The PULSESCOPE

TO PORTRAY THE ATTRIBUTES OF THE PULSE:
SHAPE, AMPLITUDE, DURATION AND TIME DISPLACEMENT

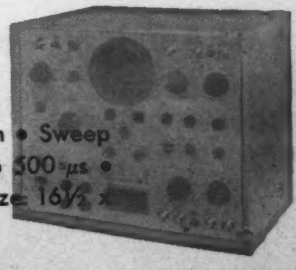
Video Amplifier up to 11 MC • Video Delay 0.55 μs
Pulse Rise and Fall Time Better Than 0.07 μs



S-4-A SAR PULSESCOPE

Video Sensitivity 0.5 v p to p/in. • S Sweep 80 cycles to 800kc, either trigger or repetitive • A Sweep 1.2 μs to 12,000 μs • R Delay 3 μs to 10,000 μs, directly calibrated on precision dial • R Pedestal or Sweep 2.4 μs to 24 μs • Internal Crystal Markers 10 μs and 50 μs • Size: 9⅛ x 11¼ x 10¼ • Weight: Less than 32 pounds.

S-5-A LAB PULSESCOPE



Video Sensitivity 0.1 v p to p/in. • Sweep 1.2 μs to 120,000 μs with 10 to 1 expansion • Sweep either trigger or repetitive • Internal Markers synchronized with sweep from 0.2 μs to 500 μs • Trigger Generator and built-in precision amplitude calibrator • Completely cased • Size: 16½ x 14⅛ x 17½ • Weight: Less than 60 pounds.

See these two NEW PULSESCOPES ...at the

Radio Engineering Show
Grand Central Palace
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BOOTH 29
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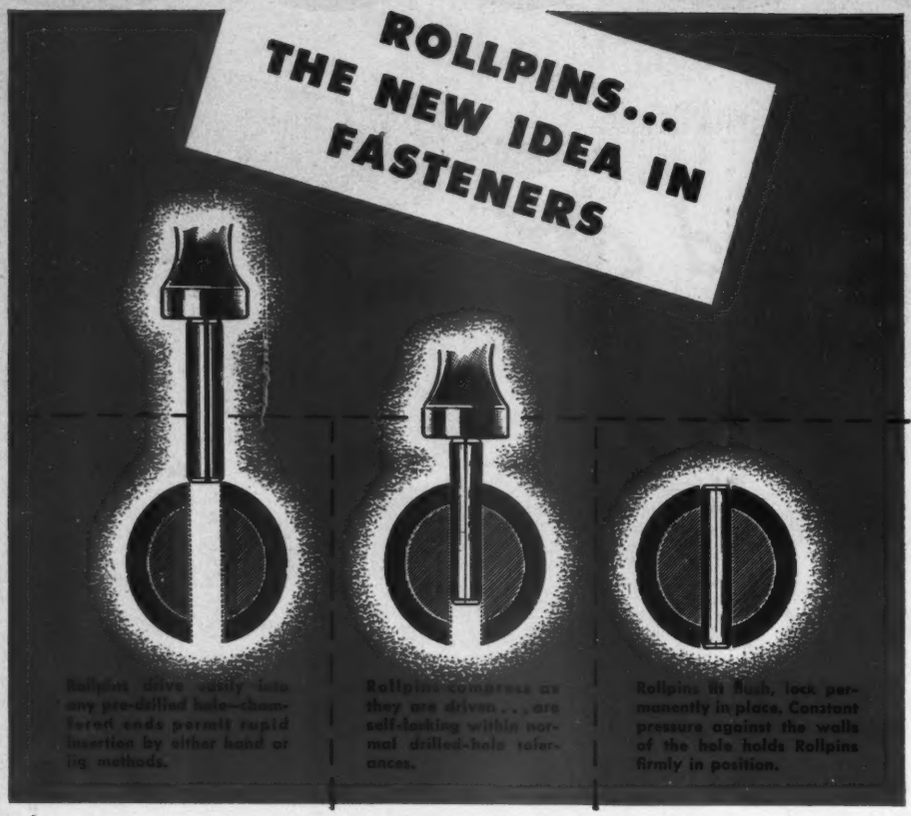
CABLE ADDRESS:
POKETSCOPE, PHILA.

WATERMAN PRODUCTS


ROLLPINS... THE NEW IDEA IN FASTENERS
Rollpins drive easily into any pre-drilled hole—chamfered ends permit rapid insertion by either hand or tooling methods.
Rollpins compress as they are driven . . . are self-locking within normal drilled-hole tolerances.
Rollpins in flush, lock permanently in place. Constant pressure against the walls of the hole holds Rollpins firmly in position.

How much can Rollpins save on your production line?

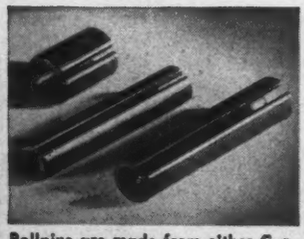
Here's important information on Rollpins—the amazing new fasteners that eliminate slow, expensive reaming, peening, and machining operations. Just imagine the cost-cutting possibilities provided by a single fastener with such wide design and application flexibility that it can replace tapered pins, grooved pins, or straight pins. Investigate the savings Rollpins offer *your* produc..

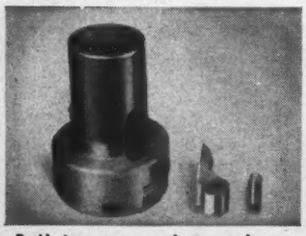
In the short period since their introduction, manufacturers are already using Rollpins as steel fastening pins holding pulleys and gears to shafts; as pivot or hinge pins, clevis pins, cotter keys, shafts, and locating dowels . . . to provide lower-cost simplified, vibration-proof assemblies.

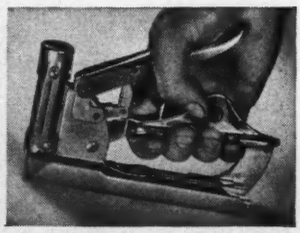
Rollpins require no special installation skills...readily replace your present fastener . . . exceed the sheer strength of a cold-rolled pin of equal diameter. Rollpins stay tightly in place until deliberately removed with a pin punch—can be used over and over again.

For complete information on Rollpins and their almost unlimited money-saving applications write to Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, N.J.

ROLLPIN
A PRODUCT OF
ESNA
ELASTIC STOP NUT CORPORATION OF AMERICA


Rollpins are made from either Carbon Steel or Stainless Steel and are readily available from stock in diameters from 1/16 inch to ½ inch and in standard lengths.


Rollpins are used to replace a hardened, ground tapered pin in this feed tube-finger clutch assembly—stand up to flexing and shock more than 2,400 times an hour.


Four Rollpins are used in this Hansen tacker as pivots. Self-retaining, they eliminate headed rivets and bolts . . . simplify repairs . . . provide a flush fit.

TELE-TIPS

WHY NOT? Honolulu's station KHON has filed an application with the FCC asking for waiver of the TV "freeze" order, and the granting of authority to construct a television station. The Hawaiian Islands, it is pointed out, are not faced with any particular shortage of TV channels under any conceivable allocation, now or later!

WE WONDER WHETHER there aren't already television bootleggers and wavetappers along the routes of the microwave TV relays! The temptation must be strong for would-be viewers who, while denied television service through the freeze of the FCC, know that main trunk lines carrying video pass close by them. It is not hard to visualize an enthusiastic viewer—ham or engineer—building a 4000 MC receiver and erecting a concealed attic or windmill antenna between two relay towers. He would presumably have the choice of four television programs at certain points along the route. But even one would be better than nothing! Reception at this high frequency would not be easy, but after demodulation an ordinary TV-receiver video section could handle the signal.

HAVE THERE BEEN any cases of bootleg mobile operation? After all, what's to prevent anyone from calling in on a mobile common-carrier phone frequency and giving a fictitious number? When the operator replies an open receiver without coding equipment will respond to the phone company's signal.

SHAPE OF THINGS TO COME is perhaps shown in the new cylindrical cathode ray tube faces. Introduced by Corning Glass, the new tube eliminates spectral reflections by having curvature in one direction only. Thus by a simple optical application the general wide reflection angles of the normal spherical section screen are removed. A combination of very slight forward tilt of the tube and the new cylindrical face eliminates reflections. Prediction: Many other television blemishes will be cured by simple applications of elementary physics.

(*Continued on page* 18)

A New Kind of Television R.F. Tuner . . . Combining the Best Features of Rotary and Turret Type Tuners !

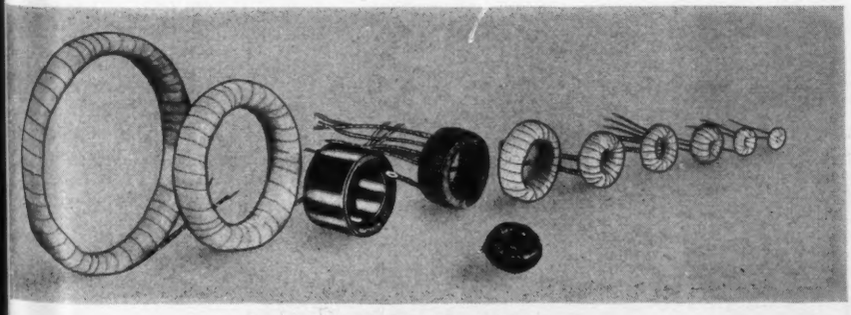
The DX Rotorette*

IMPROVED HIGH FREQUENCY PERFORMANCE

- High and substantially uniform gain on all channels.
- Good image rejection and adjacent channel attenuation because of rigid tracking and bandwidth control in manufacture.
- Excellent noise factor, low oscillator radiation and temperature compensated colpitts circuit for oscillator stability.
- Adaptable to U.H.F.
- Output designed for single or dual I.F. channel operation.

The DX Rotorette is a radically new design of turret switch tuner having an extremely low torque. The switch selects a completely tuned circuit for each channel. Having undergone an extensive period of laboratory development and field performance testing, the Rotorette assures reliable performance at an unusually low cost. Your inquiry will bring complete engineering data.

**Patents Pending and Applied For.*



DX TOROID COILS

Special toroid winding equipment has been developed over a period of ten years by DX engineers. A wide range of sizes from 3/8" to 12" in diameter can be wound to your specifications for inductances and Q values. DX Toroids and filters are available in open, cased, potted or hermetically sealed types. Send us your specifications for quotation.

Other fine DX components include Deflection Yokes, Horizontal Output Transformers, Ion Traps, Speakers, R.F., I.F., and Oscillator Coils, Special Transformers, Filters and Focus Coils.

SEE US IN BOOTH 345A AT THE I. R. E. SHOW

DX RADIO PRODUCTS CO.

GENERAL OFFICES: 2300 W. ARMITAGE AVE., CHICAGO 47, ILL.

DX COMPONENTS
"the heart of a good television receiver"
TRADE MARK

CABLES

AMPHENOL coaxial cables made with Teflon dielectric have low loss and perform satisfactorily at temperatures as high as 500° F. Covering the Teflon dielectric are two silver coated shields and two wrappings of Teflon tape. The jacket consists of two fibre glass braids impregnated with silicone varnish which is oven baked to provide maximum moisture and abrasion resistance.

CONNECTORS

Because impedance specifications of Amphenol RF Connectors can be depended on, no line unbalance is inserted, nor is the standing-wave ratio increased. Amphenol RF Connectors meet the exacting requirements of laboratory applications—have longer leakage paths, lower loss.

The 82 series connectors illustrated are weatherproof type HN connectors for use with 50 ohm cable. These connectors have full 4Kv. rating when used with Silicone Compound and may be used with 70 ohm cables when impedance is not critical.

The 83 series UHF connectors illustrated are low cost general purpose connectors ideal for laboratory applications. Not constant impedance, but suitable for general RF transmission below 160 megacycles.

Teflon inserts are standard on the connectors illustrated and will be supplied with any AMPHENOL RF connector on special order.

AMPHENOL

AMERICAN PHENOLIC CORPORATION

1834 SOUTH 54th AVENUE CHICAGO 50, ILLINOIS

TELE-TIPS (Continued)

IN THE WALDORF, near our office, determined college profs have been diligently watching seven TV sets, each tuned to a New York station. As a result they reported to FCC the following total metropolitan programs for a week: Drama, 8589 minutes; variety, 4598 min.; children's shows, 4199 min.; home-making, 3507 min.; sports, 3406 min.; stunts, contests, 2245 min.; news 1860 min.; personalities, 1432 min.; music 1222 min.; and information 1090 min.

AS REPORTED in TELE-TECH November 1950, a new approach to estimating TV station coverage has been selected. Originally NBC was the promoter of this method, now it is understood that all the networks are adopting it. The decision to include all viewers in the .1μv. contour is based on better than expected receiver and antenna performances, and the large percentage of viewers between .1 and .5 μv. contours (approximately 20%).

DEFENSE CONTRACTS—Competitive bids are showing such a wide range in prices that contracting officers are puzzled. How can bid prices be so wide apart for conventional radio items whose manufacturing specifications are defined in detail? A typical case is a radio-receiver contract for which more than a dozen bidders' prices ranged from $220 each to nearly $1,000 each! Comments have been made to the effect that some manufacturers are not familiar with government contracting and don't know how to establish costs when bidding on them. Countering this is the statement that "We have ways of reducing costs." The continued shortage of defense contracts may intensify this competition. Rising labor and material costs and increased taxes make matters worse. Manufacturers are restudying their cost-accounting systems; procurement people point-with-pride to the fact that they are saving the public money. And here and there we hear worried voices speculating about who's going to "get it" in the end.

NBC TV station WNBT expects to be first of New York transmitters to operate from the new Empire State Building composite antenna. WNBT had planned to be on the air from its new 1460-ft elevation by March 1. (For full details of this 215-ft 13 carrier antenna structure, see November and February issues of TELE-TECH.)

TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

O. H. CALDWELL, Editorial Director ★ M. CLEMENTS, Publisher ★ 480 Lexington Ave., New York (17) N. Y.

With Delays in Rearmament Orders—

Radio Industry Must Find Its Own Ways to Keep Going

Recent Pentagon conferences with leaders of the radio-TV industry have brought out some disappointing facts about electronic rearmament.

In the first half or three-quarters of 1951 there is not going to be enough rearmament business from Uncle Sam to keep the bulk of our radio TV factory organizations going. Such government orders as are left-over, after those assigned to the big companies, will be "hardly a drop in the bucket" so far as the industry as a whole is concerned.

If present radio-TV factory organizations are to be kept intact for greater electronic emergencies later, they will have to use the ingenuity and enterprise of their own management and engineers, to continue civilian work.

For materials that are in short supply, substitutes will have to be found. (Later some restriction may be relaxed as Government stockpiling progresses). And new radio and TV designs employing fewer parts and simpler circuits will have to be devised. Already there is RTMA discussion of a plan to pool "austerity" designs, circuits and materials, so that all firms may benefit.

While the administration has urged that military orders be spread among all manufacturers, the complexities of electronic equipment make it expedient that the Armed Forces deal primarily with the larger companies and specialty engineering groups—organizations large and small, which already have several years of experience with military orders

Most manufacturers will therefore have to become subcontractors, under the prime contractors or play "follow the leader" under some "leadership" plan. Others are now having their engineers check up on parts and assemblies which can be quantity-made on peacetime production-lines or in "bee-hive" layouts.

★ ★ ★

Eventually there will be big jobs ahead for the radio industry as a whole. But right now it is being left to find its own ways and means for subsistence until the big orders come through from the Pentagon!

The RADARSCOPE

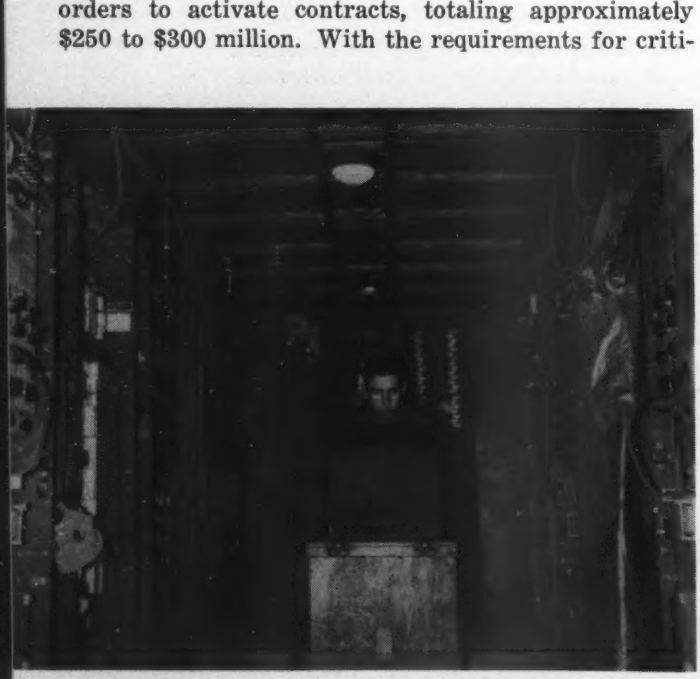
Revealing at a Glance

THE PENTAGON

10-15% OF $87 BILLION—The military procurement program for the current (1951) and for the next (1952) fiscal year (which commences July 1, 1951), is estimated to cost approximately $87 billion and, while it is still in the realm of speculation because of no definitive disclosure of the armed services' procurement, the electronic-radio proportion would be between 10 and 15 percent, it is estimated. Defense Mobilization Director Charles E. Wilson recently emphasized that the production of electronics equipment will be more complex by far than in World War II and that, while the task is difficult in its huge program, he stated "the job will be done."

AIR FORCE AND SIGNAL CORPS

HUGE QUOTAS—The procurement flow from the armed services commenced in large volume during February and by March 1 the Air Force Materiel Command planned the completion of the issuance of definitive contracts for more than 95 percent of a total of $854 million for electronic and radio equipments. This total of $854 million constituted the amount of funds for electronic radio procurement which has been made available to the Air Force in all of the appropriations for the current fiscal year of 1951, including the original funds bill of the Defense Department and the two supplemental appropriations measures. At the same time, the Army Signal Corps had issued in early February definitive contracts and procurement letter orders to activate contracts, totaling approximately $250 to $300 million. With the requirements for critical materials, necessitated by the procurement orders of these two armed services, together with those of the Navy, a sharp decline in the production of television and standard radio broadcast receivers, even "austerity" models, is the outlook during this spring and summer.



Signal Corps men at work in the carrier van at U. S. Eighth Army Headquarters, Taegu, Korea. Placement of heavier rack mounting equipment in motor trucks minimizes time required for installation and dismantling when Headquarters relocates.

MATERIALS

RELIEF from severe shortages in the critical metals needed by radio-electronic manufacturers is expected to be felt increasingly as the rate of stockpiling of such materials by the Government is slowed down below the goals originally set by Congress. Government purchases of copper, lead, aluminum and zinc have therefore been checked or stopped for the time being, since the NSRB feels that such extensive stockpiling now would seriously hurt business. Meanwhile long-range increases in production of these materials are being studied for action.

NEW DESIGNS

INCREASING SHORTAGE IN RAW MATERIALS is having its effect on inventors. We can look for more and more Rube Goldberg schemes as time goes on. The cobalt shortage, which affects loudspeaker magnets so severely, is producing plans to return to older, discarded, methods of producing noise from a radio set. It is also stimulating new design. One such plan for a loudspeaker proposes to make use of the dielectric stress between the HV on the aquadag lining of the picture tube, and a thin sheet of aluminum mounted on the exterior. This would be a modification of the familiar condenser loudspeaker and microphone. If it works, it would have the advantage of placing the sound source adjacent to the apparent source, i.e. the picture, and eliminate the existing visual/aural displacement between large screens and associated speakers.

OLD FRIENDS

ERIC JOHNSTON, remembered by Pacific Coast electrical men as a former electrical-radio distributor from that region, is expected to make an excellent national Economic Stabilizer. He is a go-getter and a doer, rather than a debater, and he has the confidence of both business men and the unions. He makes the sixth of the top Emergency officials now in Washington who have a first-hand knowledge of our own industry. Others are Charles E. Wilson, former president GE; Stewart Symington, former radio manufacturer from Buffalo; and W. H. Harrison, former chief engineer AT&T and president IT&T; William S. Paley, CBS chairman; and RCA Victor's Walter W. Watts.

SUB-ASSEMBLIES

AUSTERITY MODELS—Radio-TV manufacturers are well aware of the fact that the austerity design era on civilian goods has arrived because other vital defense industries not in the communications fields will be siphoning off a goodly portion of the raw materials they normally received. New plans emphasizing substitute raw materials or reductions in the amounts of critical raw materials used are now appearing on the drawing boards. Before actual production starts, however, it would be well to reconsider these plans from the standpoint of the replacement market. In the past many items, such as flyback transformers, r-f and i-f transformers, switching units, etc., were delivered as complete sub-assembly units. In the field, the only reason for replacement of an original frequently involved only a burnt-out winding or a broken switch-wafer. Replacement with a complete sub-assembly, while previously economical, may no longer be so from a material standpoint, and austerity designs should of course take this factor into consideration.

TV FREEZE

WHILE THERE IS YET TIME the FCC should take regard to the TV transmitters still in manufacturers' warehouses, and permit a partial lifting of the twenty-eight-month-old freeze. Already TV has proven its ability to instruct people rapidly in all types of situations; now the heaven-sent instrument for defense instruction is being denied many important cities, such as Denver, Colo., due to the lengthy deliberations of the Commission. Materials for TV station construction are still available. In the face of the emergency which is upon the country the FCC should bury its grandiose plans for a combined UHF and VHF allocation plan, and, pulling its head out of the sand, take a look at the *defense* need for additional TV service in strategic areas. Later, there will be time enough for discussion of academic UHF TV service.

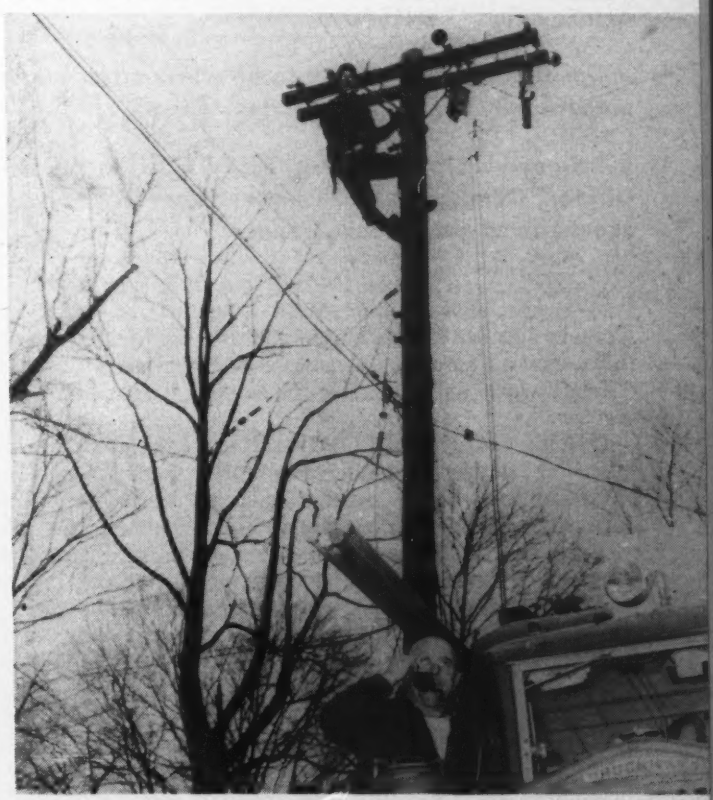
PHONEVISION

CHICAGO TESTS have shown that about 27% of the available 300 families equipped for Phonevision, paid $1 fee to see film shows during second week of January. The 9 P.M. shows pulled best, with 302 total admissions for 7 days; 7 P.M. shows, 218 admissions; 4 P.M. weekday shows, 17 admissions, and 4 P.M. Sunday, 27 admissions. Thursday was heaviest night of week in paid admissions.

SOUND SCRAMBLING will be subject to next Phonevision test, announces Zenith's Commander E. F. McDonald, Jr. Heretofore only the picture has been jiggled, leaving sound intact, so that general public could follow dialog and music clearly, despite scrambled video. Now the sound will also be garbled, shooing eavesdropping public away from channel, unless set is equipped for "unscrambling" on payment of fee of $1 per feature pix. Zenith has eleven different methods of scrambling Phonevision.

SELLING TO ARMED FORCES

HOW TO GET DEFENSE CONTRACTS—The size of the military appropriation which will be allocated for radio-electronic equipment looks good to those manufacturers feeling the pinch on essential materials for civilian production. But how to get some of this business is still a trick which many have not yet solved. TELE-TECH is nailing down this problem with a series of three articles on selling to the Navy, Army and Air Force. The data was obtained from Washington, Philadelphia, Dayton and Chicago key procurement centers. Specific, factual, realistic, it short-cuts, gets behind the scenes, goes to the source. It sheds the hokum and the gobbledegook. Since no procurement agency is handing a contract on a platter to small manufacturers, getting this business is tough going. But there is a way to go about it. The first article of the series of three, "Selling to the Navy," starts in this issue on the next page.



A crew foreman for the Niagara-Mohawk Power Corporation at Syracuse, N. Y., uses GE two-way radio in his repair truck to call for additional materials. Two-way radio helped speed up extensive repair work made necessary by recent ice and wind storms in the Central New York area.

DEFENSE CONTRACTS—
How to Sell to the Navy

By Lt. Col. STANLEY GERSTIN, Manager, Government Manuals Division, Caldwell-Clements Inc., New York City

Military to spend over $2 billion for radio-electronic equipment and components in 1951; Navy's share is $500 million.

Bulk of this business has been going to fewer than a dozen prime contractors. Smaller manufacturers, pinched by material shortages, face tough struggle for government business.

Large set-manufacturers, others in "soldering-iron" category, must revise their thinking, plan differently for prime contracts, fight for subcontracts.

General Marshall's December directive ordering dispersal of contracts and subcontracts, more negotiated contracts, broadens outlook for more equitable distribution of defense work by prime contractors among subcontractors.

Despite top-level effort to alleviate situation, most radio-electronic manufacturers face difficult days ahead.

Exhaustive inquiries by TELE-TECH in Washington, Philadelphia, Dayton, Chicago key procurement centers reveal what manufacturers should do to get defense business.

Here is specific, factual, realistic information on how to go about getting defense work as a prime or subcontractor.

It recognizes that too few manufacturers are getting the bulk of defense business; that there are not enough defense contracts to go around; that many manufacturing plants are not considered by contracting officers to have the "right" labor skill or the exact facilities; that manufacturers themselves are vague and uncertain about what they can make for defense; that much effort is wasted in the wrong places, talking to the wrong people, supplying the wrong or incomplete information; that manufacturers are overlooking subcontracting opportunities; that subcontracting is the manufacturer's best bet for getting business quickly.

What follows is not armchair strategy. It recommends the routine prescribed by the military procurement agencies when necessary; it short-cuts, gets behind the scenes, goes to the source, avoids waste motion where possible. Here is the result of an exhaustive inquiry among military and government personnel—engineers responsible for specifications on radio-electronic equipment, specialists who approve research projects, men who decide a manufacturer's eligibility as an "approved" bidder, administrative assistants who can "get you in" or give you the "brush-off."

Here are the answers to—

Who gets a negotiated contract and why?

Who is invited to bid and why?

Who gets the business and why?

What are YOUR chances of getting defense contracts as a prime contractor? As a subcontractor?

Numerous interviews with harassed officials, who let their hair down in confidence, revealed a definite pattern, a realistic, practical pattern for lining-up defense business. Some of the information is general and applies to all branches of the military. Some of it is specific and applies to the Navy, Army or Air Force, respectively.

First, the general information.

Too many manufacturers have been confused by the Plant Allocation Program conducted by the Munitions Board. These plant surveys do not automatically certify a plant for defense work. They are merely an aid in national planning and in charting production capacity. Military contracting is not guided by the findings of the Munitions Board plant survey program.

Military contracting agencies advise that "going to Washington" or other procurement centers is not necessary because you can register for contracts by mail. Recommendation is that manufacturers *should* go to Washington, Dayton, Philadelphia, Detroit, Chicago not only to register with key procurement agencies, but to speak with the administrative personnel who make the daily decisions.

But going to Washington or elsewhere is not in itself the answer to getting defense contracts. Bear in mind that top-level planning agencies do no defense procurement, per se. Collective problems of the industry interest officials of planning agencies. If you call on them, pitch your objective to their level, it won't get you a contract but you will get a load off your chest.

Military and civilian procurement is composed of people trying to do a job. They read the papers, watch television, have personal problems of their own. They are harassed by worried manufacturers, or their representatives, who haunt the halls of contracting agencies, and frequently unburden themselves on a hapless official (usually the wrong one).

There is no need for running around in circles—at least the circles can be drawn as tightly as possible. Plan your actions. Don't call on the wrong people. "Knowing" someone in contracting or procurement offices, or in engineering de-

WHERE TO SELL RADIO-TV, RADAR, COMMUNICATION, GUIDED MISSILE, ELECTRONIC EQUIPMENT and COMPONENTS for DEFENSE

NAVY PROCUREMENT OFFICES

Washington 25, D.C. and Field Offices

BUREAU OF SHIPS

18th & Constitution Ave. NW, Wash. 25, D.C.
Liberty 5-6700

CONTRACT INFORMATION:
Rm 1025 — M. Chemsak — Ext. 63362
(Mfrs must see on initial call; by appointment only)

PURCHASE BRANCH:
Rm 1028 Cdr. E.M. Fagan Ext. 63746

ELECTRONICS SECTION:
Rm 1409 Wm. Floyd Ext. 61803
(Where contracts for electronic items are let)

Asst. CHIEF for ELECTRONICS:
Rm 3020 Capt. W.H. Beltz Ext. 61714
(Discuss BuShips electronic needs and adaptability of Mfr's facilities)

ELECTRONICS DESIGN & DEVELOPMENT DIV.:
Rm 3308 Capt. C.L. Engleman. Ext. 64586
(Discuss engineering specifications, design requirements, suitability of Mfr's product)

BUYS SHIPBOARD APPARATUS, COMMUNICATION EQUIPMENT, RADIO, RADAR, SONAR, ELECTRONIC END ITEMS

ELECTRONIC SUPPLY OFFICE

Great Lakes, Ill. — Great Lakes 2300

NAVY PURCHASING OFFICE:
844 N. Rush St., Chicago, Ill. — Mohawk 4-3300

PROCUREMENT OFFICER: Lt. R.H. Diggle
(Where electronic component contracts are let)

BUYS COMPONENT ITEMS FOR STOCK AND REPLACEMENT FOR BuSHIPS. BUYS ALL TUBES FOR ENTIRE NAVY.

BUREAU OF ORDNANCE

18th & Constitution Ave. NW, Wash. 25, D.C.
Liberty 5-6700

CONTRACT DIVISION:
Rm 3149 — Capt. G.H. Wales — Ext. 61657
(Administrative responsibility for issuing contracts)

BID PROCUREMENT:
Rm 3151 Capt. H.T. Dinsmore Ext. 63276
(Issues fixed price contracts)

NEGOTIATED PROCUREMENT:
Rm 3151 H. M. Tayloe Ext. 65879
(Issues cost-plus (open price) contracts)

MATERIAL DIVISION:
Rm 0321 — Capt. R.L. Adams — Ext. 62427
(Discuss electronic needs and suitability of Mfr's facilities)

RESEARCH & DEVELOPMENT DIVISION
Rm 0447 — Capt. M.R. Kelley — Ext. 63343
(Discuss engineering specifications, design requirements, suitability of Mfr's product)

BUYS FIRE CONTROL (GUIDED MISSILES), INSTRUMENTS, VARIOUS ELECTRONIC END ITEMS USED ON OR WITH ORDNANCE EQUIPMENT.

BUREAU OF AERONAUTICS

18th & Constitution Ave. NW, Wash. 25, D.C.
Liberty 5-6700

CONTRACT DIVISION:
Rm 2W04 — Cdr. A.R. Weldon — Ext. 62905
(Where contracts for electronic items are let)

ELECTRONICS PRODUCTION BRANCH:
(PRODUCTION DIVISION)
Rm 2n88 — Lt. Cdr. M.S. Jones — Ext. 64423
(Discuss engineering specifications on electronic equipment)

BUYS AIRBORNE EQUIPMENT, AVIATION ELECTRONIC END ITEMS

AVIATION SUPPLY OFFICE

700 Robbins Ave., Philadelphia 11, Pa.
Pilgrim 5-8000
ELECTRONIC STOCK CONTROL OFFICER
Lt. Cdr. George Wolfe

BUYS COMPONENT ITEMS FOR STOCK AND REPLACEMENT (except tubes which are purchased by the Great Lakes Electronic Supply Office); also REPLACEMENT TEST EQUIPMENT FOR BuAIR

OFFICE OF NAVAL RESEARCH

17th & Constitution Ave. NW, Wash. 25, D.C.
Building T-3 Liberty 5-6700

CONTRACT DIVISION:
Rm 2801 — Ltd. Cdr. J.B. Scratchard — Ext. 65321
Rm 2808 — J.E. Kahelin — Ext. 64629

CONTRACTS FOR RESEARCH SERVICES FROM SCHOOLS, RESEARCH ORGANIZATIONS AND RESEARCH ENGINEERS; ALSO BUYS DEVELOPMENT EQUIPMENT.

NAVAL RESEARCH LABORATORY

4th St. nr Chesapeake Ave. SW, Wash. 25, D.C.
JOhnson 3-6600

SUPPLY OFFICER:
Lt. Cdr. F.A. Whitaker — Ext. 445
(Where laboratory equipment contracts are let)

BUYS ELECTRONIC, RADIO, SOUND, COMMUNICATION EQUIPMENT, COMPONENTS, TEST INSTRUMENTS

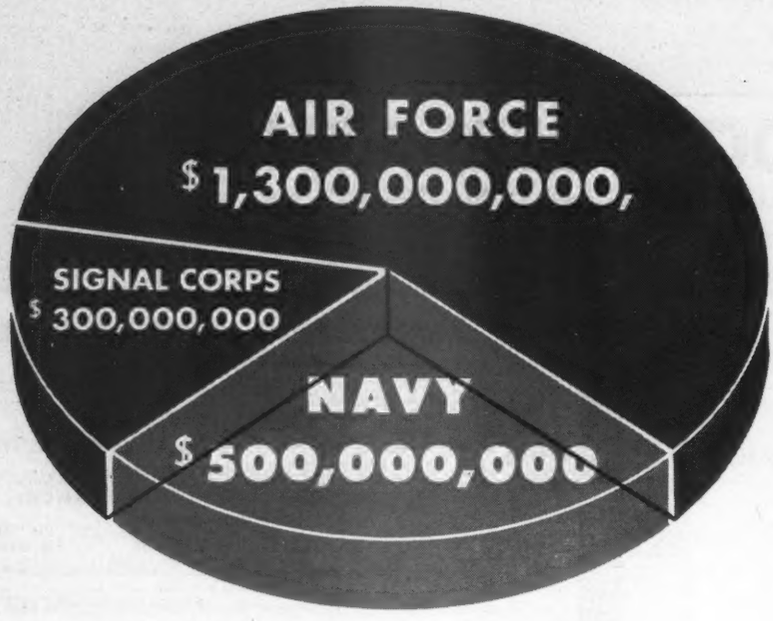
FIELD OFFICES

U. S. NAVY SHIP STORE OFFICE:
29th St. & 3rd Ave., Brooklyn, N.Y.
SOuth 8-0110

NAVAL ORDNANCE PLANT:
Macon, Ga.

(Above two field offices buy PORTABLE RADIOS, ELECTRICAL ITEMS, etc.)

Limited purchases for local use are made by Stations and Field Offices. For complete list of locations, addresses and what they buy, in detail, write for "Purchased Items and Purchasing Locations, U.S. Navy" from Supt. of Documents, Govt. Printing Office, Wash. 25, D. C. Price 20 cents.



1951 Radio-Electronic Equipment for Defense: $2,100,000,000

partments where basic specifications and engineering requirements originate, will help in that it gives you someone to call on to discuss your particular problem or someone to whom you can turn for information. By diligent inquiry, you can find out whom to see, and go in "cold."

Procurement offices are trying to discourage manufacturers from "barging" in and the Navy has set-up a buffer office for the Bureau of Ships. Your reception, wherever you barge in, to quote the words of an important military contracting official, "depends on personality, timing and general impression made by the visitor."

Here are some answers to questions frequently asked of the men responsible for military procurement.

Who gets a negotiated contract and why?

"Manufacturers whose plant facilities are well known to us, or who have convinced us that they have the necessary know-how."

"Manufacturers who have long-established research and development facilities specializing on engineering problems of direct interest to the military."

"Manufacturers with past experience on a particular military item are given contracts because of this experience."

"Classified equipment requiring research or developmental changes cannot be placed on an advertised bid basis. These are awarded to manufacturers with security clearance, and who are currently geared for this work."

Who is invited to bid and why?

"Those with World War II experience in a particular field."

"Manufacturers who have sold us on their facilities and responsibility."

"Manufacturers who follow us up; who show a definite interest and desire to bid; who convince us that they can do the job."

Who gets the business and why?

"The bulk of the business has been going to a limited number of manufacturers because they are already set up to handle government work."

"Manufacturers with 'soldering iron' production lines do not meet current requirements for quick military procurement; neither do they have the specialized personnel."

"There are already more experienced facilities available than we can use, so how can we spread the work in industry any more than we do?"

"Many manufacturers come to us and say that 'they can make anything'. What we need is a specific item, not *anything*. If the manufacturer can't be specific about what he can make, it's not for us to tell him—especially if there is no shortage of facilities like his in the first place."

What are YOUR chances of getting defense contracts as a prime contractor?

Right now they are slim. This is bitter fact. There isn't enough business to go around. What there is, is specialized. Military agencies are not launching any wide-scale program for all-out conversion. Limited plant conversion isn't expected to help hundreds of small manufacturers; and even some big names which we could mention have been left on the outside, looking in.

Given time, manufacturers will get some relief, but it will be tough going for them until that time arrives. Civilian production of "austerity" designed products will help bridge the gap. More scarce materials may shortly be released.

What are YOUR chances as a subcontractor?

Herein lies your best opportunity today. The limited number of prime contractors who are receiving the bulk of defense contracts are definitely making an effort to subcontract as much of their component production as possible. Considering the time, energy and expense involved, many manufacturers will do much better by concentrating their efforts at subcontracting rather than at prime contracting.

Even here, manufacturers will run into some exasperating situations. For instance, contracts for classified work cannot be obtained unless a manufacturer has security clearance. But security clearance cannot be obtained unless you have a contract. It's a vicious circle. Military procurement agencies will initiate a request to the Security Inspector (each service has its own independent set-up) if the particular procurement agent is convinced that you are the only one, or one of a very few, best qualified to perform a particular job. Your reputation helps convince him of this, but most likely he is decided by the fact that you have research and development facilities and specialized engineering experience with the particular equipment.

For quick results, obtain a subcontract from a prime contractor who already has security clearance. This prime contractor can request

clearance for a subcontractor whom he intends to use in performance of any part of a classified military contract. Even so, it may take more than six months to get clearance unless the prime contractor also requests that priority be given to your case—and the security inspector is convinced that priority is indeed necessary. Under the best circumstances, getting security in the present emergency is difficult and long-drawn out. Manufacturers are advised not to under-estimate its importance or the amount of time and energy that should be put into the effort. The matter of security clearance should be given priority in your planning for defense work.

Since subcontracting provides many manufacturers with the best opportunity for getting defense business, it is fairly unanimous among purchasing agents and government contracting officers that subcontractors should go about it as follows:

1. Prepare a complete report of your facilities; particularly floor space, number, type and capacity of machines, number of employees, background of engineering specialists, identity of officers, incorporation data (date, place, capitalization), length of time established, kind of business, inventory, annual volume, sales organization, branch offices, etc.

2. Itemize types of operations or products which your plant facilities can handle. Don't say you can make "anything." Don't list items which your plant cannot make or on which your engineers are inexperienced. Secure lists of component items from the various military procurement agencies. Check off those items which you *think* you can make. Request Federal specifications for manufacturing the items which you check (if it is an item from the Bureau of Ship's component list, the Federal engineering specification for its manufacture is available from the Bureau of Ships). Study the specification to determine if you can really make the component.

3. Supply yourself with samples of similar components which you have made; if necessary, actually make a component according to the Federal specification to establish a cost basis for pricing.

4. Now determine which military agencies buy the component or end item which you have definitely established can be made in your plant. Determine which prime contractors need this component for their defense contracts. Do this by studying government contract awards available free each week from regional offices of the Department of Commerce (in all large cities). The procurement chart published as part of this article provides this information, in general terms, for the Navy. The information is also available in considerable detail from commercial publications whose sole function is to recapitulate government and military contracting information and invitations to bid on government contracts.

5. Once you have established what your plant can produce and have some satisfactory evidence of this, and have determined who could use this particular component, make personal sales calls on prime contractors. See the chief engineers, the purchasing agents and the managers of government contracting.

6. If you are taking your product or evidence of your ability to produce certain components to military agencies, register with each military agency with whom you wish to do business.

a. Request that your firm be placed on the qualified bidder's list and file the necessary papers to accomplish this. Forms are available from each procurement office. Bear in mind that military buying is decentralized for the most part (details on the Navy are given in the procurement chart with this article). If you register with the Navy's Bureau of Ships, you may also want to register with the Bureau of Aeronautics, Bureau of Ordnance and the Office of Naval Research. If you register with the Navy, you will also want to register with the Air Force and with the Signal Corps.

b. Remember that it is not enough to register with the Navy in Washington where most end items are purchased. Register also with Navy Procurement in Chicago, where all component items for stock and replacement are bought for the Bureau of Ships, and in Philadelphia where components for the Bureau of Aeronautics are purchased, etc.

7. Research and development contracts are generally obtained directly from the research laboratories and not from procurement offices handling end items and components. In any case, the research engineers must be "sold" first.

For selling to the Navy, study the revised and detailed procurement chart accompanying this article. It furnishes accurate information on who buys what. This is the first time so factual and specific a chart has been published with key names, addresses, room numbers and telephone extensions. (Even though rooms and phones may change from one week to the next due to rapid expansion of offices, this chart will save time and energy.)

The Bureau of Ships buys the bulk of the Navy's radio-electronic equipment. Key purchasing offices are in Washington (for end items) and Chicago (for components). To register as an approved agency with the Bureau of Ships, it is not required, but is highly desirable, to personally visit the information officer, as indicated on the chart.

Here is a tip. All military serv-

(*Continued on page* 84)

NAVY

PROCUREMENT PUBLICATIONS

***Purchased Items and Purchasing Locations of the Department of the Navy*—Available from the Procurement Central Information Office, Room 3E813, Pentagon Building, and from the Supt. of Documents, Govt. Printing Office, Wash. 25, D. C. Price 20 cents.**

***Selling to the Navy*—Available from the Supt. of Documents, Govt. Printing Office, Wash. 25, D. C.**

***Index of Specifications (MIL and JAN Standards)*—A complete Federal index of all specifications. Available from the Government Printing Office. Price $1.50. It lists every end item and component specification available, by identifying number and issuing agency.**

Where to Sell to the

U.S. COAST GUARD

13th & E st., NW.,
Washington 25, D. C.

SUPPLY DIVISION
Cdr. W. W. Childress

PROCUREMENT SECTION
Lt. Cdr. F. P. Bergmeister
(Where contracts are let)

BUYS TRANSMITTING EQUIPMENT, RADIO, RADAR, COMMUNICATIONS, RADIO BEACON, ELECTRONIC AIDS TO NAVIGATION.

COAST GUARD
SUPPLY CENTER
345 Warren St., Jersey City, N. J.

Lt. Cdr. Leo T. Robbins,
Commanding Officer, Supply Center

Lt. Cdr. Bob Kisten, Electronic Officer
(Coordinates electronics purchasing)

TV Sound Diplexer for

Design details of submitter and subceiver units that facilitate

L. STASCHOVER and H. G. MILLER
Federal Telecommunication Laboratories, Inc.
Nutley, N. J.

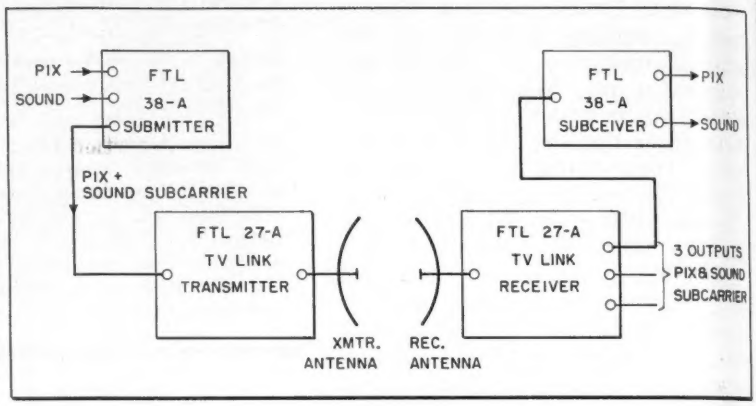


Fig. 1: Operation of audio submitter and subceiver in conjunction with UHF TV relay link

DIPLEXING, in the present case, refers to the addition of a sound signal to the composite television picture signal for simultaneous transmission over radio relay links. Telephone lines and separate ultra-high-frequency radio links are normally used for these sound transmissions. Both of these systems have the disadvantage of high cost and the sound-program radio link raises the additional question of dependability.

There exists a pressing need for equipment that will transmit high-quality sound programs over existing television radio relay links to eliminate the need for additional high-quality telephone circuits or microwave sound links. The specifications for such an equipment are as follows:

(a) The system must meet high standards as regards distortion, cross talk, and noise. (b) It should work over any existing wide-band relay link without modification of the link. (c) When used with a repeater chain, no new processes or equipment should be introduced in the program channel at intermediate repeater points. (d) It should be convenient to monitor the sound at any point. (e) Simplicity of the equipment and of its operation, adjustment, and maintenance should be combined with small volume and low initial and operating costs.

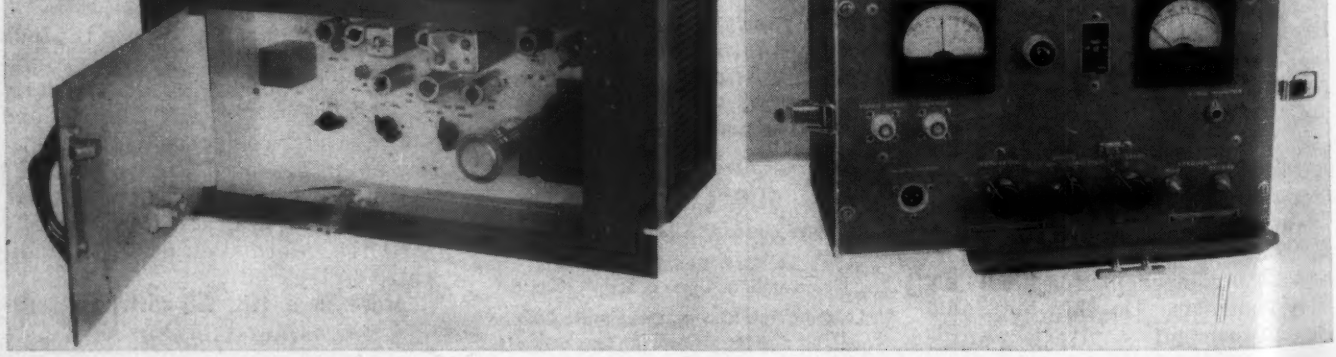
To devise such a system, frequency-division and time-division methods were employed and tested overall several years.

In a time-division system, a pulse might be added to the video signal during the horizontal-blanking or "back-porch" time. This pulse could be either time- or width-modulated. With this system, the highest audio frequency that can be transmitted is limited to half the horizontal-line frequency, or about 750 cps. It also becomes necessary to restore the standard composite video signal by complete removal of the added pulse at the receiving end of the link.

Frequency-division diplexing involves translation of the audio-frequency spectrum to a position slightly above the maximum video frequency. It may then be transmitted through the relay system as a simple addition to the video signal. Another method involves amplitude modulation of the relay-system carrier at a sound-subcarrier rate.

Each of these methods possesses certain advantages and disadvantages. Exclusive tests and analyses indicate that a practical approach is to use relatively narrow-band frequency modulation by the sound signal of a carrier at the high-frequency end of the video-signal spectrum. This is the basis of the *FTL-38A* system to be described.

Fig. 2: (left) Rack mounted model of audio submitter. (right) Portable submitter unit measures 14 x 9 x 9 and weighs 16 lbs.



Studio-Transmitter Links

simultaneous transmission of audio and video over microwave relay links

Since the standard video-frequency band entends to 4.5 MC the sound center frequency may be conveniently placed at 5 MC. The amplitude of this sound subcarrier is made small compared to that of the picture signal to avoid interference with the normal operation of the radio link.

The primary problem in the simultaneous transmission of sound and picture signals over a common link is that of cross talk from the picture into the sound channel. In the frequency-modulation system, cross talk of this type stems from two sources.

First, nonlinearity in the amplitude characteristic of any component in the relay link will produce amplitude modulation of the frequency-modulated wave by the picture signal. For example, if synchronizing-signal compression is present, the gain of the relay system is not the same at the level of the synchronizing-signal tip as it is at the white-signal level. Hence the amplification of the low-level sound signal will depend on the instantaneous picture-signal amplitude. If the sound-channel receiver fails to remove the resultant amplitude modulation completely, some of the picture signal will appear in the output along with the sound modulation.

The second source of cross talk is nonlinear time delay in the radio and intermediate-frequency portions of the relay link. Phase nonlinearity, which is the same as nonlinear time delay in frequency-modulation systems, is analagous in its effects, such as distortion and intermodulation, to nonlinear amplitude characteristics in amplitude-modulation systems. If, say, two audio-frequency signals are applied to a distorting amplifier, sum and difference frequencies in addition to harmonics are produced. In frequency-modulation systems, such amplitude distortion is of no significance, provided limiting is effective, but phase distortion will produce harmonic and sum and difference terms.

The equipment is designed for the transmission of high-fidelity sound over any wide-band relay system. It consists of two units, a sound-channel "submitter" that serves to introduce the sound-program material at the sending end of the link, and a sound-channel "subceiver" that recovers the signal at the receiving end. The operation of this equipment in conjunction with a relay system, such as the *FTL-27* ultra-high-frequency television relay link, is illustrated in Fig. 1.

Submitter

The submitter accepts both the picture and sound signals, generates and frequency modulates the sound subcarrier, adds it to the picture signal, and applies both to the transmitter of the relay link. In practice, the amplitude of the frequency-modulated wave amounts to less than 10% of the picture-signal white level and thus has negligible effect on the performance of the relay link. At the receiving end of the link, this process is reversed; the video- and audio-frequency signals are made available separately. The diplexing equipment is self-contained and self-powered, and there are no connections to the radio relay link other than those indicated in the figure.

The video-frequency levels at the input and output terminals are 2 volts peak to peak into 75 ohms. The minimum audio-frequency input level to the submitter is 10 db below 1 milliwatt (—10 dbm). However, a volume control makes possible the acceptance of levels up to 10 db above 1 milli-watt. The rated subceiver audio-frequency output is +18 dbm; and standard audio-frequency impedances, such as 600, 150, and 50 ohms, balanced and unbalanced, are available at both ends of the system.

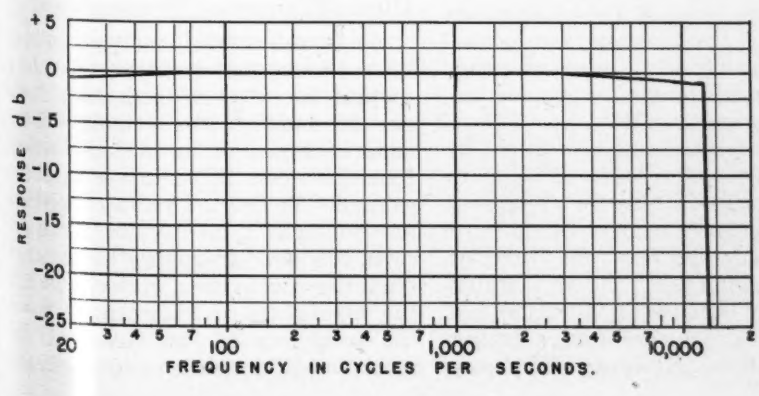
The heart of the submitter is an oscillator-modulator circuit that generates a 5 MC frequency-modulated signal. The maximum peak to peak modulation swing is ±50 WC. The center frequency is stabilized with reference to a 5 MC discriminator, whose output consists of the demodulated audio-frequency signal and a direct-current error voltage proportional to the drift of the oscillator from the center frequency. The audio-frequency signal is metered by a volume indicator to show the percentage modulation, and the error voltage is fed back to the oscillator-modulator to correct for the center-frequency error.

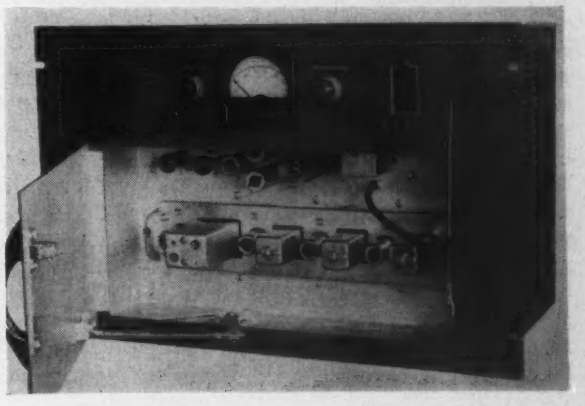
The frequency-modulated sound output is applied to a cathode-follower buffer-amplifier, combined with the video signal, and applied to the F5-ohm line. The amplitude of the frequency-modulated wave in the line is continuously variable up to a maximum of 0.5 volt, peak to peak.

The submitter is available in two

(*Continued on page* 86)

Fig. 3: (left) Low pass filter in subceiver limits audio response to 12.5 KC. Fig. 4: (right) Photo of rack mounted subceiver





Measuring Ti

Long range deter. continued despite

Fig. 1: View of measuring equipment at WWVH, Mauri, T.H. Shown are standard oscillators consisting of crystal-controlled bridge type oscillators, buffer amplifier, and two amplifier output stages. Temperature is controlled by mercury-glass thermostats and inner bridge type heaters. Batteries are used to power this equipment

By V. E. HEATON, National Bureau of Standards, Washington 25, D. C.

STANDARD frequency radio station WWVH (located at Maui, T. H.) has been in experimental operation since November 1948. The installation is very similar to that at WWV.[1] Its frequency and time determining equipment consist of three independent standard oscillators which are operated continuously from batteries. Each of these standards is essentially the same, consisting of a quartz crystal-controlled, bridge-type oscillator, a buffer amplifier and two output amplifier stages. The temperature control consists of an inner bridge-type heater, and an outer heater controlled by a mercury-glass thermostat working through an electron tube and a relay to control the heat. A photograph of this apparatus is shown in Fig. 1.

Two separate frequency dividers and clocks may be controlled by either of the three frequency standards. These dividers are of the regenerative-modulator type[2] and divide from 100 KC to decimal submultiples and 60 cycles. The 60-cycle output operates a synchronous motor clock from which cam-operated contacts and electronic circuits generate seconds pulses; these pulses are used for frequency and time determinations and are also used in generating or marking other accurate intervals of time: 1 minute, 4 minutes, 5 minutes, etc. Each of the standards is periodically adjusted to compensate for normal drift and to keep its frequency very close to that of WWV.

Synchronizing Radio Stations [3, 4]

If two or more stations are operated on the same nominal frequency, a primary requirement is extremely close agreement between the frequencies as broadcast. If the stations are within a reasonable distance of one another this agreement may be maintained by a transmission line over which a frequency may be sent to each station. This line frequency may be used to control the transmitted frequencies or to adjust local frequency standards to agreement. Any phase shifts which occur in the line or its associated apparatus would cause frequency variations at the transmitter. Poor signal to noise ratios on the line would cause noise on the transmitter output. If the stations are located some thousands of miles apart a wire line for synchronization may be impractical economically.

Quartz-crystal oscillators might be periodically calibrated and sent to the operating stations for frequency control. Such standards would vary in frequency between the time of calibration and the time of installation mostly because of vibration and changes in temperature during transportation. However, frequency deviations could be maintained less than 1 part in 10^7 with presently-available quartz-crystal units.

It is possible to link the stations by a system of radio relay stations. The overall installation cost of this type of control might be less than that of transmission lines but its reliability and maintenance requirements are not sufficiently well known.

Another method, presently in use and described in this paper, is to make relative measurements of the frequency and time of the different stations. Data so obtained are processed in an approved manner and a value of frequency is immediately determined for each station. The oscillators at all stations are then adjusted for more precise agreement of the frequencies broadcast.

The frequency and time standards at WWVH are checked once every twelve hours with reference to the received signals from WWV, at 0900 to 0940 and 2100 to 2140 HST (1400 to 1440 and 0200 to 0240 EST) when the path for the received signal is expected to be most stable.

At present the monitoring is done in the WWVH transmitter building. This requires that the transmitters be off for the 40-minute measuring period. A radio receiver connected to a rhombic or Yagi antenna, oriented on WWV, is used. The 100-KC frequency from a local standard oscillator is fed to a frequency multiplier or harmonic generator. Output from this generator, along with the WWV energy from the receiving antenna, is fed to the radio receiver. This gives the desired difference frequency in the receiver's output.

Direct Frequency Measurement

As is well known, energy radiated by a transmitter is propagated to a distant receiver by reflection from one or more of the principal ionospheric layers, or by multiple reflections between these layers and the ground. As long as radio conditions are constant, a fixed receiver will receive the same frequency as radiated from the transmitter. However, when the layers are moving up or down the frequency of the signal at the receiver will decrease or increase, re-

Time and Frequency in Hawaii

mination of standard frequency transmission characteristics
propagation vagaries due to distance and ionospheric variation

spectively, and will, therefore, depart from the transmitted frequency. The degree of this departure increases with the speed of the motion, in accordance with the familiar doppler effect. The variations in height of the reflecting layers are a function of time of day, time of year, geographical location and sunspot activity. Although on the average the conditions are such that the constancy of the path-length may be predicted, however, at a particular time the actual conditions may be far from the average. The height of the ionosphere layers is relatively stable over the Washington-Maui path when noon or midnight occurs at a point half way between the transmitter and receiver.[5, 6]

As an illustration of the possible magnitude of such an effect let us assume that a principal reflecting layer (F_2 layer) is the one from which the reflections take place between Washington and Maui (4800 miles great circle distance), and that the height of this layer changes from 200 to 230 miles in one hour. For a three-hop transmission, i.e., three reflections from the ionosphere and two from the earth, the received signal would be approximately three parts in 10^8 lower in frequency, perhaps, per hop, than the transmitted one. For the total distance the effect might be expected to be less than three times this amount as the changes in layer height might be less on two of the three hops.

For direct frequency measurements the radio receiver should be fed approximately equal energy from the local standard harmonic generator and the WWV antenna. When reception is good the difference frequency is indicated as a variation in the S-meter reading on the receiver. During interference and fading, listening to the beats helps in choosing the desired beat from any undesired ones. The number of beats and corresponding time in seconds is determined, using a stop watch, for a period long enough to give the desired accuracy. This measurement should be made two or three times to check the timing. When fading is severe, more measurements over

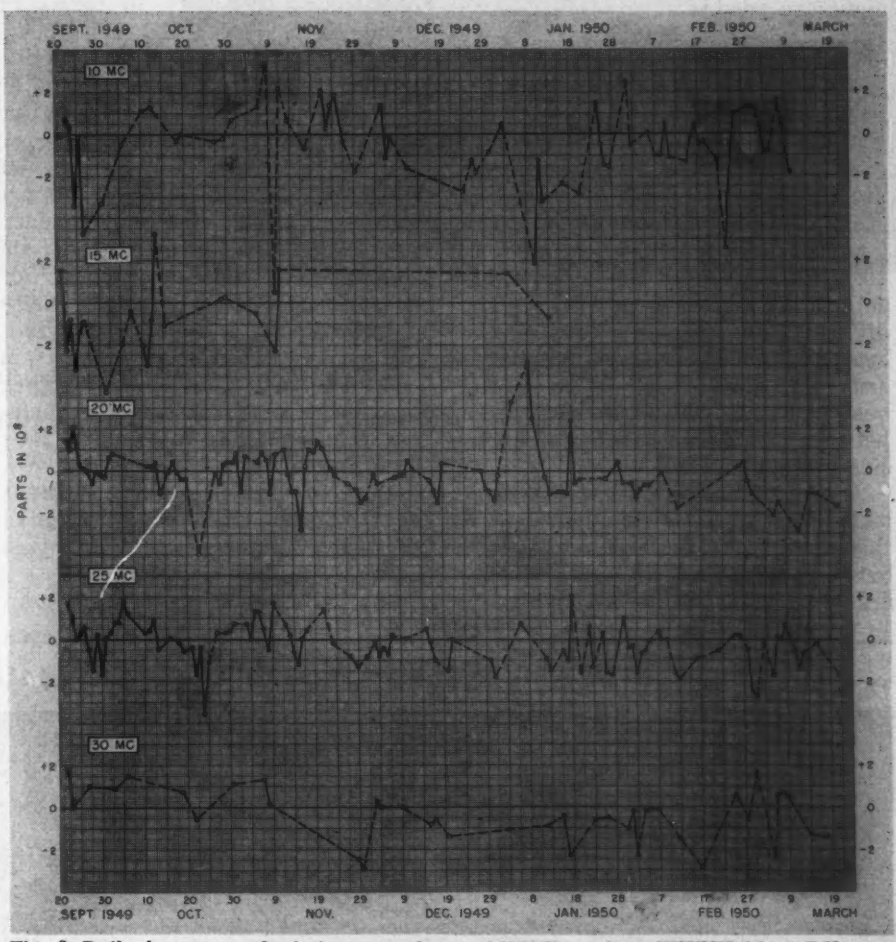
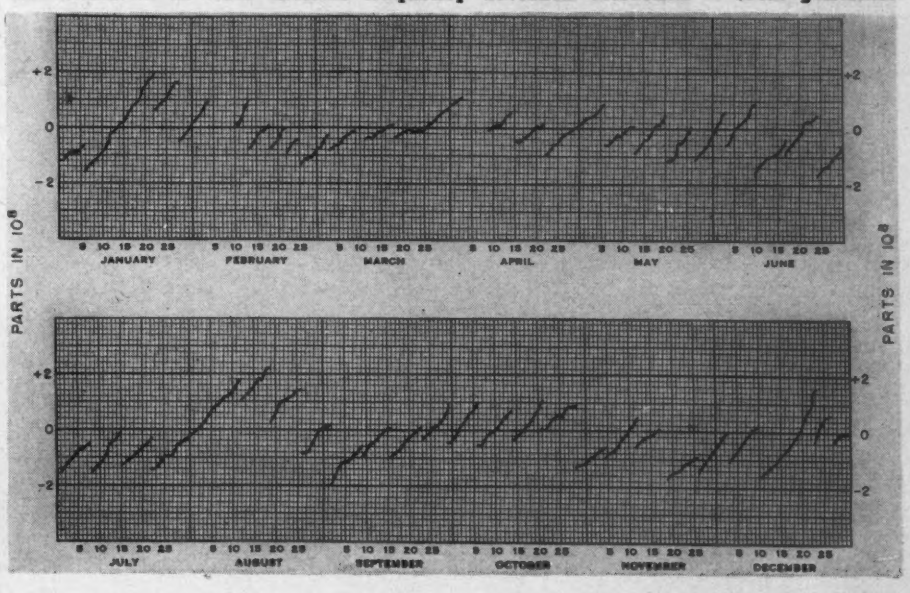


Fig. 2: Daily frequency deviation recordings of WWV, made at WWVH, Maui, T.H., note superiority of higher frequency transmissions which produced more consistent results

Fig. 3: Graphs of daily frequency errors compared with WWV broadcast by WWVH; discontinuities in trace indicate frequency deviation correction to local generator



TIME AND FREQUENCY (Continued)

shorter intervals should be made. Individual cycles may be added or suppressed by fading. These should be ignored and the count continued at the same rate during a measurement. Recording of beats is preferable as it permits more precise analysis of results when the receiving conditions are good.[7]

Experience at Maui has shown a considerable difficulty in determining the frequency difference when it was small. This was caused by variations in received signal strength (fading). Therefore, during a measurement, the frequency of the spare standard was purposely adjusted low in frequency by about one part in $10.^{7}$ It then could be most readily determined in terms of WWV. The difference in frequency between the local main, spare and standby standards was then obtained using the beat method. Thus the difference between WWV and WWVH frequencies was determined.

A typical example of a measurement at Maui is as follows: assume that the beat difference, at 20 MC, between WWV and the spare standard "S" (which is known to have a frequency less than 100 KC) is 34 beats in 100 seconds. The frequency difference would be the number of beats per second, 0.34. Therefore standard "S" has a frequency difference in terms of WWV of —17 parts in 10^{9}. Let us assume that the counted beat for the standard "M" (controlling WWVH) in terms of standard "S", at 10 MC, is 16 beats in 100 seconds. This frequency difference is +0.16 cycles per second or +16 parts in 10^{9}. Adding these two values algebraically we find the error of WWVH in terms of WWV is -1×10^{9}.

In Fig. 2 are shown frequency measurements made in this way on consecutive days. A number of measurements were omitted because of interfering stations, rapid fading, or very weak signals from WWV. It may be noted that higher frequencies gave much more consistent values than 10 MC and 15 MC; 2.5 MC and 5 MC were not received. The agreement between consistent data is of the order of ± 2 parts in 10^{8} with a few values in error by as much as 1 part in 10^{7}.

Another method of frequency determination, based entirely on the rate of the clock at WWVH, gives high precision data for measuring periods of one day or greater in spite of the various difficulties. The value of frequency so obtained is an average. But as the oscillator drift and change in drift are quite small and predictable, average frequency during a period will be the same as the instantaneous value for the middle of that period.

A cathode-ray oscilloscope is used in comparing the local seconds pulses with those received from WWV. The linear sweep circuit is controlled at 60 cycles per second from the frequency dividers which provide the seconds pulses and other frequencies to the local transmitters. The local seconds pulses are connected to the vertical deflection and the oscilloscope is adjusted so that they start at a reference line marked on the screen. Then the local seconds pulses are replaced by those from WWV fed from the radio receiver through a filter to eliminate the unwanted modulation. These pulses, as received, may be multiple during the first 0.2 second of each second. This may be caused by paths of different lengths including round-the-world

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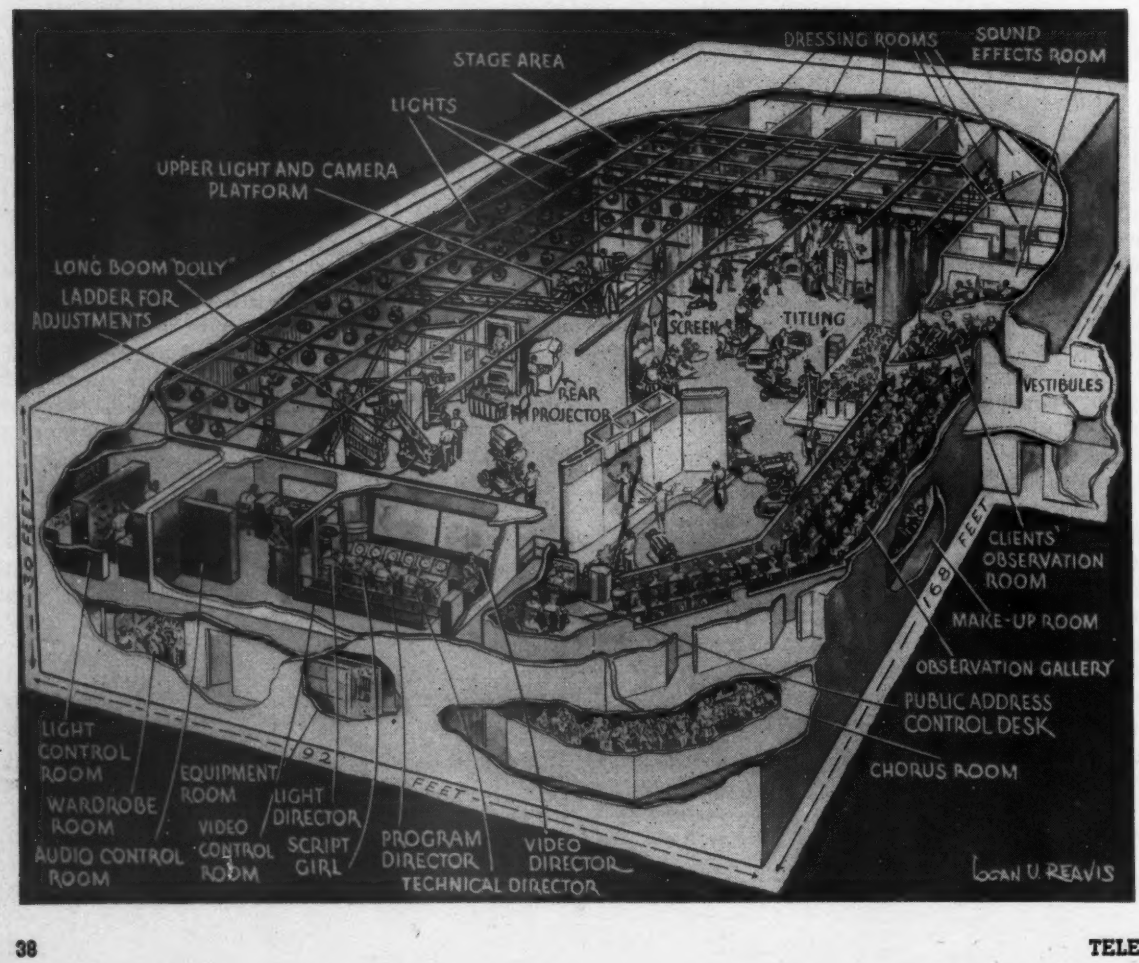
NEW NBC TELEVISION STUDIO COVERS HALF CITY BLOCK



Studio 8-H at Radio City, New York City has a volume of 300,000 cubic ft., 6 TV cameras, 3 control rooms, 15 dressing rooms, completely equipped stage 30 ft. deep, and over 1,000 lamps. It is the most extensively equipped TV studio in the world. All the lighting is hung on horizontal pipes which can be raised and lowered as required. Lighting, audio and video control rooms are provided with nine monitors for the directorial staff. The stage is at floor level thus making it possible to run cameras on to the stage for special productions without building runways. Among the effects provided are: motor driven title machines; transistor for dreams, etc.; and rear projection facilities.

Low-Noise Silver-Printed Television Tuner

By *HARRY KAYNER*, *Project Engineer*
Hoffman Radio Corp., Los Angeles, Calif.

New close-tolerance silver-deposit process makes possible an inductive type tuner with linear elements for use in fringe areas

THE advent of large scale commercial telecasting has seen an almost continuous growth in service area by the use of more elaborate antenna systems in fringe areas. There is, however, a limit to the expansion even with the most elaborate antenna system, and herein lies the importance of a good tuner, having an exceptionally low noise factor to utilize low signal strength and produce acceptable pictures under these fringe area conditions. Many localities suffer fringe area operation relatively close to the transmitter due to shadows caused by buildings, mountains, and other obstructions.

For this type of operation a television tuner was developed by the Hoffman Radio Corporation which has an exceptionally low noise factor and permits satisfactory operation under conditions of fringe area signal strengths. This tuner utilizes an unusual type of printed circuit linear tuning elements to provide essentially continuous tuning through approximately 330° rotation for the twelve assigned television channels. The tuner was in development for over two years, primarily due to the fact that previously known printed circuit techniques were incapable of producing circuits having sufficiently close physical tolerance to permit mass production.

The original idea for the Hoffman Silver Circle Tuner was conceived by Carlton Wasmansdorff, who was responsible for the basic circuit design and much of the original research work. The several design factors which were given major consideration in the conception of this tuner are as follows: noise factor; gain; image ratio; i-f. ratio; spurious response ratio; selectivity; oscillator drift; continuous tuning; ease of tuning; long life; ease of production; low cost.

Circuit Design

The tuner circuit diagram of Fig. 1 is seen to consist of a neutralized push-pull 6J6 RF Amplifier and a 6J6 converter oscillator. The 6J6 RF amplifier was chosen primarily due to its low noise factor, after having examined all tubes applicable for r-f amplifier stages in the VHF television range. Neutralization of the r-f amplifier stage is necessary and is achieved through C2 and C3; the latter is adjustable and is a factory adjustment. To improve further the noise factor of the tuner itself the antenna input circuit is tuned to produce maximum antenna gain. This also improves image and i-f ratios and tends to reduce the spurious response ratios as well.

The tuning elements indicated as L2, L3, L6, L7, L10, L11, L14, and L15 consist of folded transmission lines printed on phenolic plates. A pair of antenna plates is shown in Fig. 2, together with shorting bar. Fig. 3 shows the construction of these plates, together with the location of the channels. Originally the design was intended to have channels uniformly spaced throughout 330°. However, it was found that to get sufficient band spread for the channels below 6 it was necessary for them to occupy a greater portion of the angular rotation, as it was desired to have a band spread per channel of one and one-half negacycles. To reduce the angular rotation would have necessitated printed circuit line widths which were impractical for production line operation. Had more space been available for the tuner, permitting a larger diameter for the printed circuit transmission line, an entirely uniform scale could have been developed; however, it was felt more desirable to reduce size than to have uniform channel spacing.

Band pass coupled circuits are provided between the r-f amplifier and converter by the utilization of two pairs of printed circuit lines, L6, L7, L10 and L11. Link coupling, as well as capacitive coupling, is utilized to provide reasonably uniform bandwidth over the twelve channels; this varies from approximately 4.5 MC at Channel 2, to 7 MC at Channel 13. The oscillator circuit consists of inductances L14 and L15 which are ganged to the antenna and r-f amplifier inductances by shorting bars mounted on a common shaft. One of the many advantages of this type of printed circuit transmission line design is the fact that perfect tracking between the oscillator and r-f sections may be achieved by designing the printed circuit config-

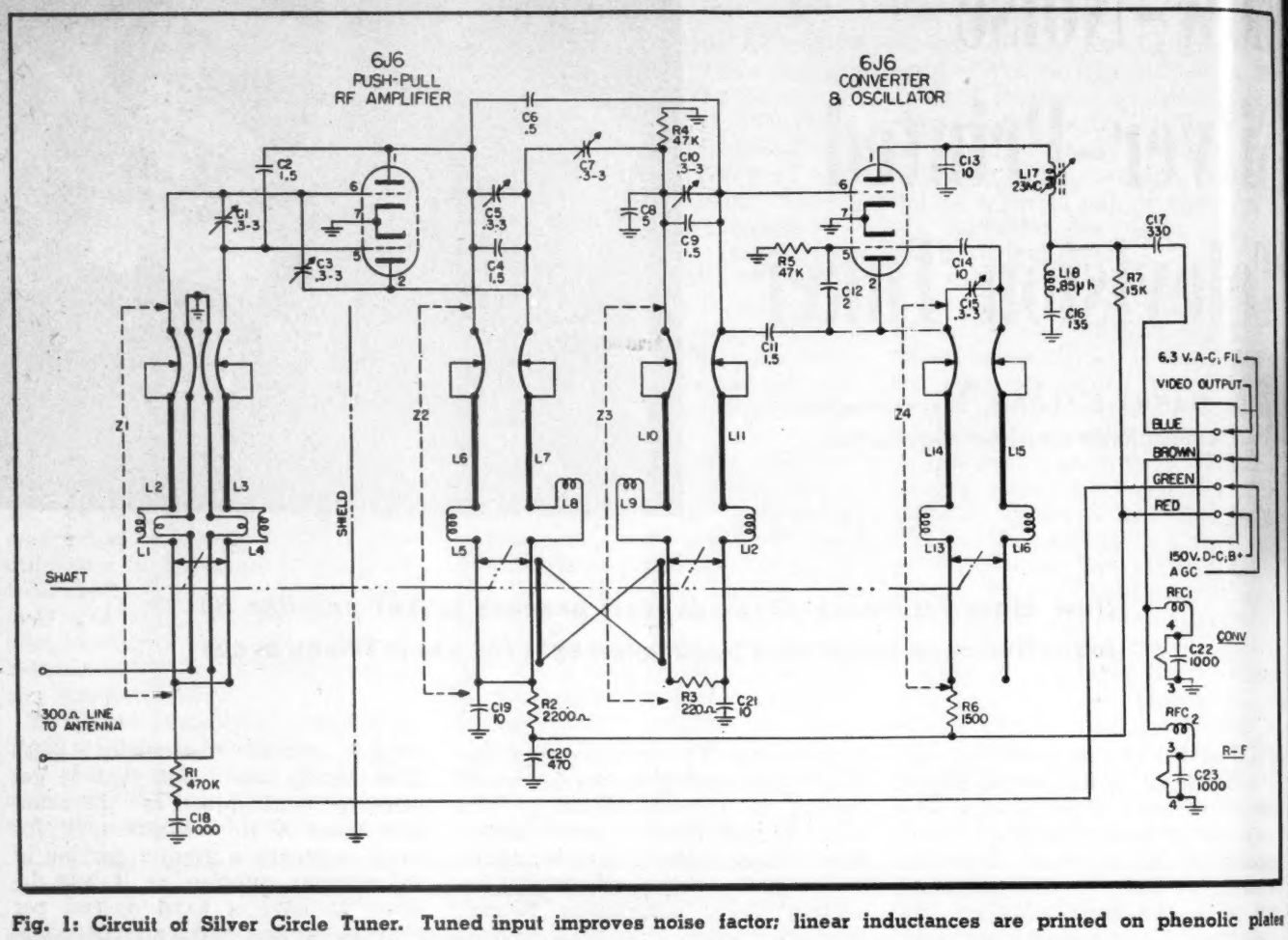


Fig. 1: Circuit of Silver Circle Tuner. Tuned input improves noise factor; linear inductances are printed on phenolic plates

uration to provide this tracking. This is illustrated by the oscillator plates shown in Fig. 4. An assembled tuner with the bottom shield removed is shown in Fig. 5. The four pairs of printed circuit plates may be seen grouped together, through them passes a common shaft on which is mounted the four shorting contacts.

The concentric shafts extending forward from the tuner are part of a ball planetary transmission which has a five to one ratio between the outer and inner shaft and results in the extremely low rotational torque of 2 in. ounces. This low torque is achieved by virtue of the fact that

Fig. 2: Actual identical antenna plates deposited on plastic

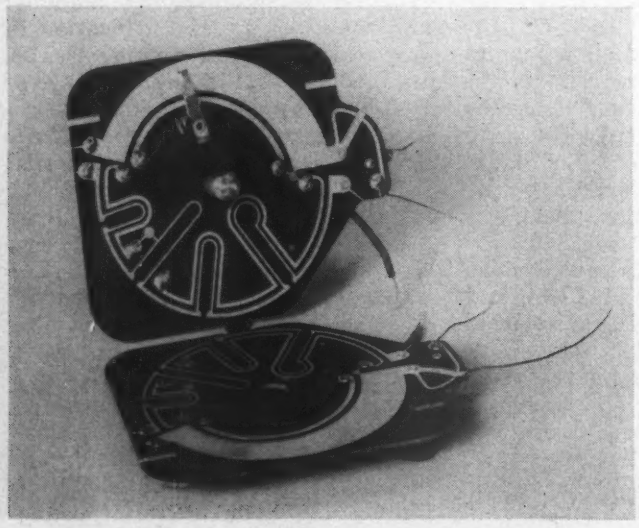
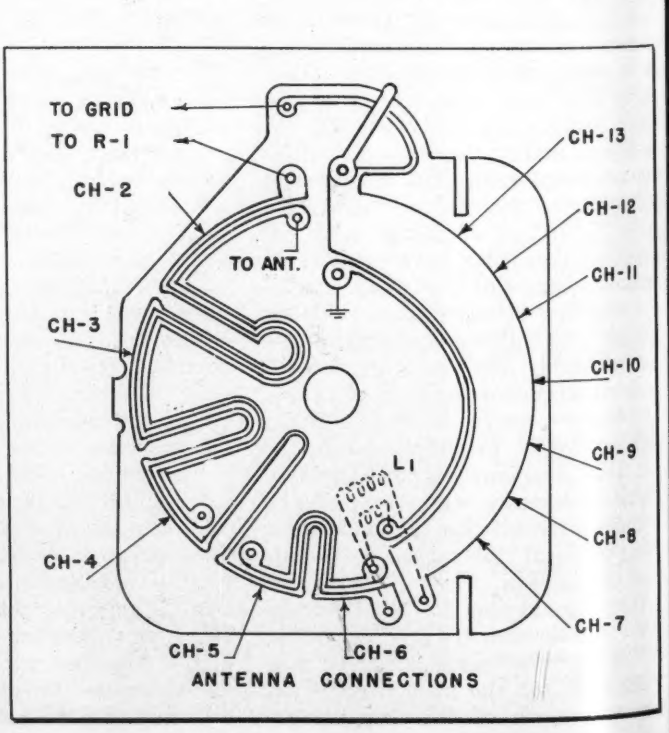


Fig. 3: Details of plates and locations of channels



the contact pressure of the four shorting bars is only 0.8 ounces. Such a low contact pressure, while effecting a good r-f short between pairs of plates, produces negligible wear on the printed circuits, the surfaces of which are silver plated.

Life tests indicate the wear is a burnishing action which is essentially completed during the first one to two thousand cycles of operation. No perceptible wear appears beyond that point up to one hundred thousand cycles of operation.

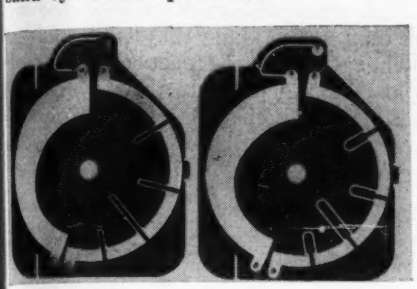


Fig. 4: Oscillator plates—note tracking

The electrical performance of the Silver Circle Tuner is shown below, and it is seen that the original objectives have been achieved. Of particular note is the noise factor of the tuner, which varies from approximately 4 to 8 db.

Innumerable field tests have been made in fringe area locations where essentially all the noise received was that due to the antenna radiation resistance and the noise generated within the tuner itself, and in all cases, the superiority of Silver Circle Tuner with its low noise factor, is evident when compared with tuners having the usual noise factor of 14 to 20 db above thermal.

Much of the success of this tuner is dependent upon the printed circuit itself. The printed circuit development and processing techniques have been developed by Charles Daniels, Chief Mechanical Engineer, and John W. Daniels, Mechanical Engineer, of Hoffman Radio Corporation. The printed circuit process finally selected is based on a photo etching process, known in the printed circuit field, utilizing paper base phenolic support on which a .0012 in. copper foil is laminated. After the circuit is etched the circuit is silver plated.

The principle problem in obtaining satisfactory results in the use of this printed circuit technique is a matter of achieving sufficiently close mechanical tolerances so that no electrical adjustments of the plates are needed after fabrication. The width of the narrow lines on the printed circuit is .020" for the r-f circuits. The rate of change of inductance is illustrated in Fig. 6 which indicates the necessity of holding these line widths very accurately. This is particularly important at Channel 2, since the accumulated errors in line width all tend to misplace this channel from its mechanically calibrated position.

As shown in Fig. 4, "Equivalent Oscillator Configuration", it is possible to obtain the same inductance by two widely different loop shapes. The plate on the left side of the photo shows the shape originally

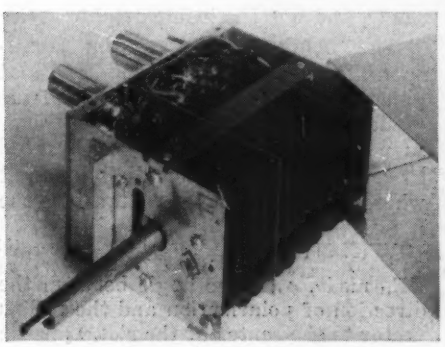


Fig. 5: Tuner has eight inductances

used. This consisted of narrow loops with lines 0.020 in. wide. When it was found too difficult to hold this to ± .001 in. the plate on the right was designed to correct or alleviate this trouble. A change of 1.8 mils made about the same percentage change as a 1 mil variation shows in Fig. 7, which is for the left hand plate.

The size and spacing required to

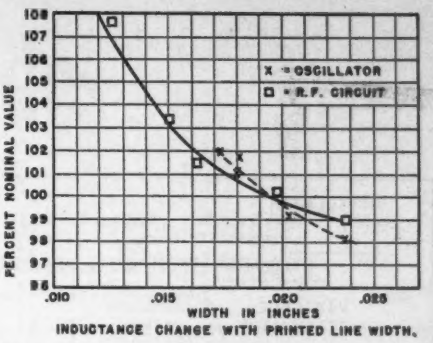


Fig. 6: Inductance depends on line width

make a loop substitution for an equal inductance can be approximated. The inductance of a two wire line (or its impedance) is proportional to a constant times the logarithm of b/a; where "b" is the distance between centers and "a" the radius equivalent to the surface divided by 2 π. The method is incremental. Steps taken are as follows: (1) The loop line width is increased and the distance between lines widened permitting the fraction b/a to increase to 2/1.5. The logarithm is .124 and is the increment due to the loop. (2) The line itself however has decreased as its value of "b" has not changed. The fraction b/a has the value 1/1.5 and its logarithm is .823. Therefore 1.124 x .823 = 0.93, indicating that the overall effect has not changed appreciably. This permits a first printing and an easy correction to obtain the exact value.

Production Operations

The assembly of the Silver Circle Tuner is relatively simple. All wiring associated with the printed circuit plates is done prior to assembly on the individual plates which are readily handled. The eight plates are subsequently assembled in a jig in their proper positions together with the end shields, which are then staked to the chassis which has been previously wired. At this point the relatively few interconnecting wires between the plates and the circuitry on the chassis are made which completes the wiring of the tuner. To insure low production reject rate on alignment of the tuner, all plates are checked for inductance in an Inductance Comparator after which the tuner is aligned.

One of the major factors in the production cost of television tuner is the alignment time. The Silver Circle Tuner has a total of 24 factory adjustments. In a jig, and with specially designed test equipment it is possible for a trained operator to align a tuner completely in a matter of 4 to 5 minutes.

*PERFORMANCE CHART**

CHANNEL	SENS.	IMAGE db	IF REJECTION db	BALANCE RATIO	GAIN db	NOISE FACTOR db	OSCILLATOR △ F Kc
2	18	48	61.4	65	31	4	70 L
3	20	50	63	79	31	3.9	
4	24	51	62	91	31	4	2 L
5	24	52	60	72	30	4.5	
6	26	56	62	54	27	4	5 H
7	50	50	61.4	8	25	8.8	27 H
8	52	49	62.6	9	24	7.9	
9	47	48.2	61.7	11	24	8.0	
10	55	49.5	60.6	13	23	7.8	176 H
11	57	46.8	60.2	14	23	8.5	
12	67	44	60.6	12	22	8.3	
13	65	55	59.4	9	20	8.8	130 H

* Stability is reached in 15 minutes

Properties of Longitudinal

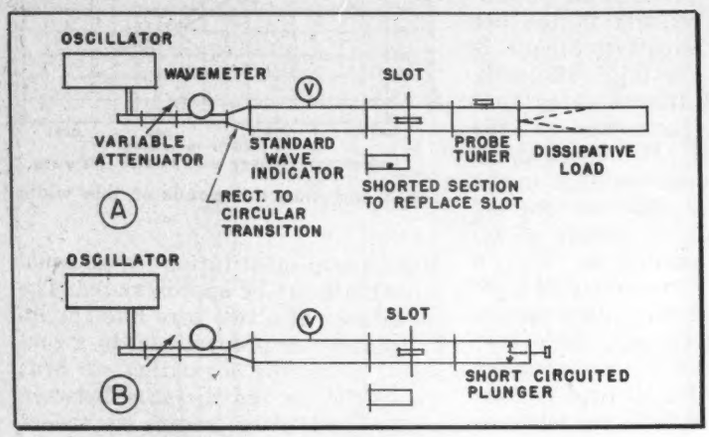


Fig. 1: Equipment employed for the measurement of slot admittance

Longitudinal slots in circular guides of measurements on narrow and wide

By C. E. FEIKER and S. C. CLARK, JR.

General Engineering Laboratory, General Electric Co.

Schenectady, N. Y.

ALTHOUGH considerable theoretical and experimental material is available on slots in a rectangular guide, very little information is available on slots in circular guides.[1] It is the purpose of this paper to show that the case of a longitudinal slot in a circular guide is analogous to that of a longitudinal slot in the broad face of a rectangular guide and to present experimental evidence of the effect on slot characteristics of the means of radiating the energy coupled with the slot. Radiation patterns and power breakdown characteristics are included.

Silver[2] has derived an expression for the equivalent shunt conductance of a longtiudinal slot in the broad face of a rectangular guide. The result is:

$$g = \frac{480}{73\pi}\,\frac{a}{b}\left(\frac{\lambda_g}{\lambda_0}\right)\cos^2\left(\beta_{10}\,\frac{\pi}{4}\right)\sin^2\left(\frac{\pi x}{a}\right) \quad \ldots\ldots (1)$$

where β_{10} is the phase constant for the TE_{10} mode, λ_0 is the free space wavelength, λ_g is the guide wavelength, X_1 is the displacement of the center line of the slot from the center line of the broad face, a is the inside width of the guide, and b is the inside height.

The conductance for the corresponding case of a longitudinal slot guide, and b is the inside height of the guide.
in a circular guide has been derived by a similar analysis with the result where β_{11} is the phase constant for the

$$g = \frac{480}{73\,(2.38)}\left(\frac{\lambda_g}{\lambda_0}\right)\cos^2\left(\beta_{11}\,\frac{\lambda_0}{4}\right)\sin^2\phi_0 \quad \ldots\ldots (2)$$

TE_{11} mode, ϕ_0 is the angle between the direction of polarization and the radius vector to the center of the slot, λ_0 is the free space wavelength, λ_g is the guide wavelength.

Experimental results cited by Watson indicate that a narrow longitudinal slot in rectangular guide has the characteristics of a series resonant circuit shunted across the equivalent transmission line. It has been found that the analogous case of the circular guide has the same type of characteristic. Measurements made at X-Band on half wave slots 1/16 and 3/32 inch wide cut in a circular waveguide indicate that these slots have the same type of equivalent circuit.

Measurements of Narrow Slots

Measurements of the admittance of a longitudinal slot in a circular waveguide have been made over a band of frequencies about the resonant frequency. A slot 0.633 in. long, equal to half the free space wavelength of 3.20 cm, was cut in the wall of a circular waveguide having an inside diameter of 0.875 in. and a wall thickness of 0.625 in. The ends of the slot had a radius one half the width for ease in machining. Slot widths of 1/16 in. and 3/32 in. were used. Measurements of admittance were made using both resistive and reactive wave-guide terminations.

The apparatus for the method of measurement employing a matched resistive load is shown in Fg. 1a. The standing wave indicator used was a 7/8-in. I.D. coaxial slotted line with center conductor removed. The source was coupled to the S. W. I. through

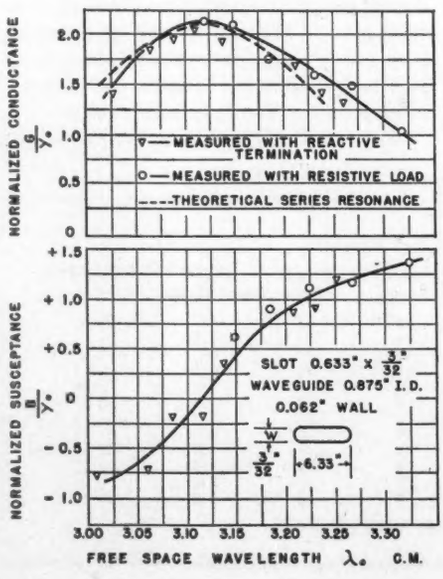


Fig. 2: (left) Theoretical curve for conductance based on assumption that slot is represented by series resonant circuit in shunt with the transmission line

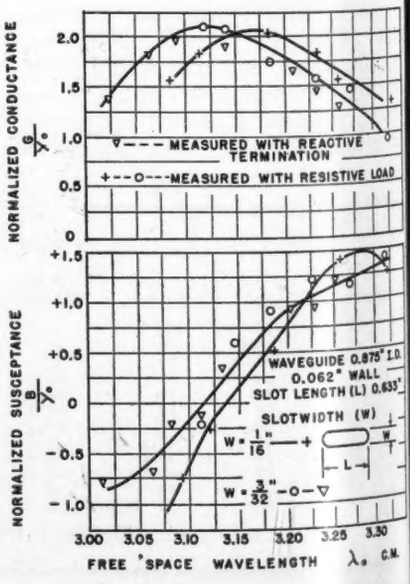


Fig. 3: Increasing slot width with fixed length decreases resonant wavelength

1. W. H. Watson "Wave Guide Transmission and Antenna Systems," Oxford 1947.

2. S. Silver, "Microwave Antenna Theory and Design" Radiation Laboratory Series, Vol. 12, McGraw-Hill 1949, Chap. 9.

Slots in Circular Waveguides

considered analagous to those in broad faces of rectangular types. Results slots, radiation patterns, and power breakdown characterictics are presented

standard rectangular X-Band guide fittings and a rectangular to circular waveguide taper section.

The resistive load consisted of a 24-in. section of soft white pine with a 12-in. conical taper placed in a short-circuited circular waveguide. This load had a VSWR of less than 1.05 over the entire band and was somewhat better than a similar load with a 12-in. wedge taper. By means of the probe tuner, this load was matched at each frequency prior to measurement to have a VSWR of less than 1.03, usually as low as 1.01.

A shorted section of waveguide was used to replace the slot, tuner, and load. The position of the short was the same as the center of the slot and served to locate the minimum of the standing wave pattern with respect to the slot. With the slot and matched load in place, the shift of minimum from the reference point and the VSWR were measured. From these measurements the normalized conductance and susceptance of the slot were calculated.

In the second method of measurement a variable reactor consisting of a short circuiting plunger replaced the proble tuner and resistive load as shown in Fig. 1b. The plunger was adjusted for the lowest minimum of the standing wave pattern indicating least radiation from the slot. The plunger was then readjusted for the lowest value of VSWR, indicating that the susceptance of the slot had been tuned out by the reactor. The value of the minimum VSWR was then equal to the normalized conductance of the slot. The shift of the plunger position between first and second adjustments was used to calculate the susceptance of the slot.

Results of admittance measurements on narrow half wave slots 0.633 in. long by 1/16 and 3/32 in. wide, respectively, are shown in Figs. 2 and 3. As shown in the figure, these slots were cut with semicircular ends. Data for both methods of measurement are included for the 3/32-in. slot and indicate good agreement as shown in Fig. 2. The normalized conductance at resonance measured 2.1, as compared with a value of 2.3 calculated from Equation (2). It is to be noted that the

Table I: Dimensional Data on Longitudinal Slots Measured

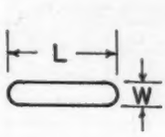
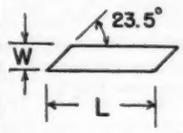
SLOT	W	L	λ_R	$\frac{L}{\lambda_R}$	$\frac{\text{PERIMETER}}{\lambda_R}$
	1/16"	0.619"	3.066 CM	0.512	1.085
	1/16"	0.633"	3.137 CM	0.513	1.085
	3/32"	0.633"	3.116 CM	0.516	1.12
	1/8"	0.650"	3.250 CM	0.507	1.50
	3/16"	0.717"	3.35 CM	0.544	1.81

Fig. 4: Increasing the slot length will increase the resonant wavelength

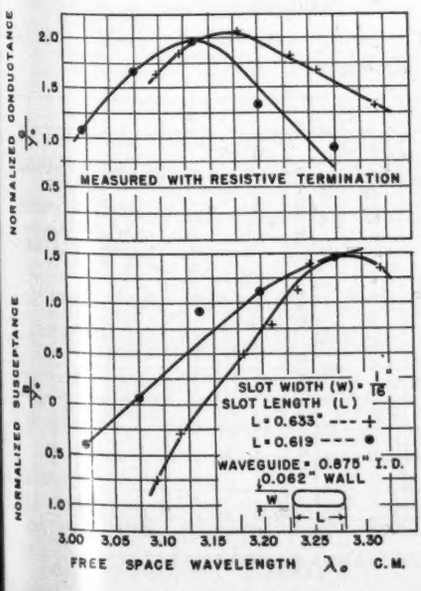


Fig. 5: Conductance at resonance is higher than for same slot without plates

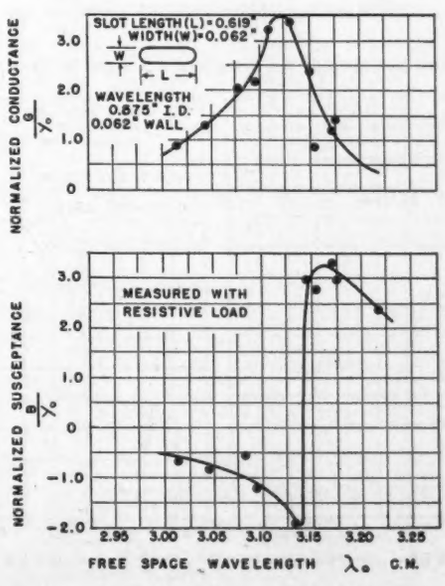
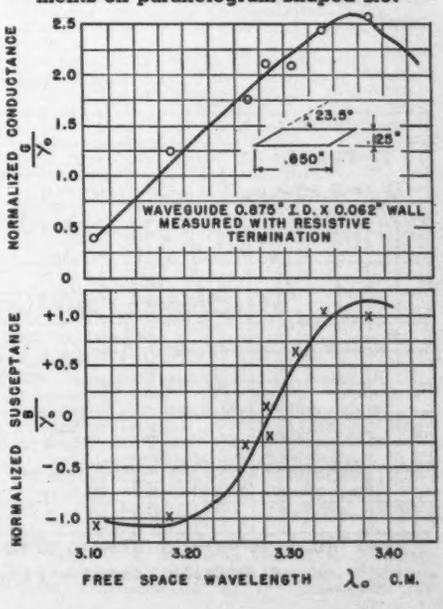


Fig. 6: Results of admittance measurements on parallelogram-shaped slot



LONGITUDINAL SLOTS (Continued)

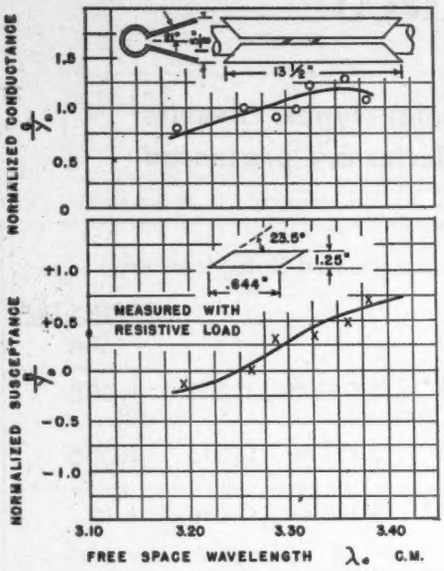


Fig. 7: Admittance characteristic of parallelogram-shaped longitudinal slot that is feeding an E plane flared horn

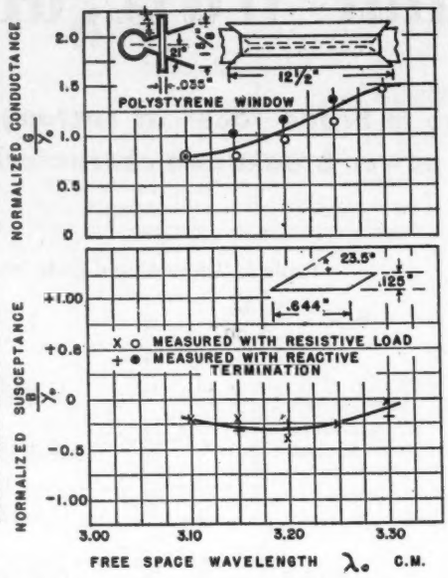


Fig. 8: Diagram showing the results of measurements made on the admittance of a pressurized horn assembly

susceptance of the slot has a positive slope with increasing wavelength, which is characteristic of the shunt equivalent of a series resonant circuit for certain values of resistance. This is a desirable property in that the susceptance of the slot can be tuned out by a pure reactance having a negative slope of susceptance with wavelength.

In Fig. 2 is shown the theoretical curve for conductance based on the assumption that the slot is represented by a series resonant circuit in shunt with the transmission line. This curve, which was calculated from the measured values of susceptance and the conductance at resonance is in good agreement with measured values of conductance, indicating that the slot is series resonant.

The effect of changes in slot dimensions on resonant wavelength is illustrated by the data of Figs. 3 and 4. Fig. 3 shows that changing the slot width from 1/16 to 3/32 inch with a fixed slot length, which increases the perimeter by 2.5%, decreases the resonant wavelength by about 0.7%. From Fig. 4 it is seen that increasing the slot length by 2.3% from 0.619 to 0.633 in. increases the resonant wavelength by 2.3%. These and other data tabulated in Table 1 indicate that the resonant wavelength is a linear function of slot length rather than perimeter.

Measurements of admittance were also made on the 1/16 x .619 in. slot when radiating between two foot diameter plates spaced 1 in. apart. This is the same arrangement used to obtain the radiation pattern of Fig. 9 as will be explained in a later section. The admittance data presented in Fig. 5 indicates that the conductance at resonance is somewhat higher than for the same slot without plates. The increased conductance of the slot is reflected in the susceptance characteristic, which is typical of a series resonant circuit with low resistance. The presence of the parallel plates also introduced sufficient local reactance to cause a slight shift of resonant frequency.

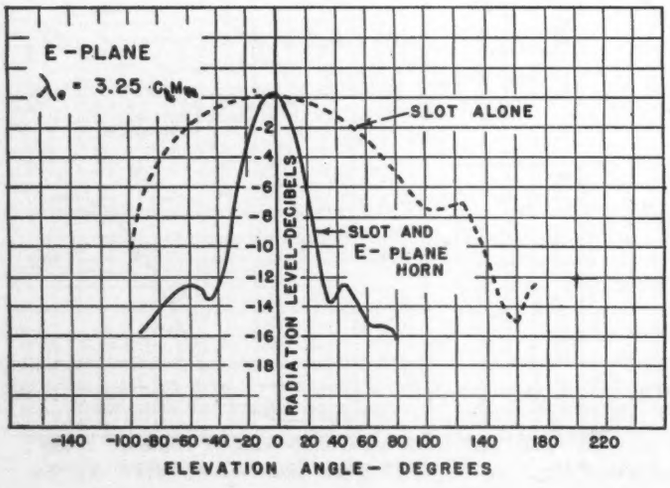
Admittance of Wide Slots

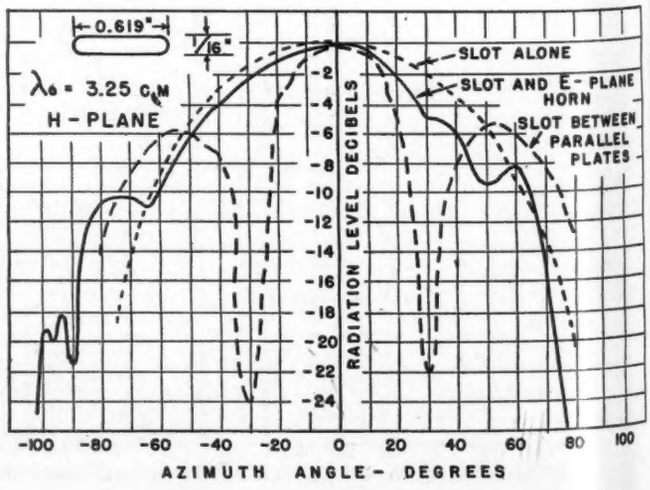
Admittance measurements have been made of somewhat wider slots having the shape of a parallelogram. Fig. 6 gives the results for a 1/8 inch wide slot. Both methods of measurement gave results which are in fair agreement. The slot resonates at 3.25 cm, corresponding to a slot length equal to 0.51 of a wavelength. The admittance characteristics of a longitudinal slot of parallelogram shape feeding an E-plane flared horn having a total flare angle of 42° and E-plane aperture of 1⅝ in. are shown in Fig. 7. It will be noted that the conductance with attached horn is about one-half that of a slot alone, as shown in Fig. 6. The admittance of the parallelogram slot alone at 3.3 cm. is 2.5 + j0.15, while with the horn it is 1.04 + j0.28.

The results of measurements made of the admittance of a pressurized horn assembly are shown in Fig. 8. As originally designed, the horn flare was preceded by a parallel plate pillbox about a quarter wavelength long of 1/8 in. spacing. With this construction the conductance was very low, between 0.2 and 0.3, so that very little radiation was obtained. Elimination of this pillbox section so that the horn flared directly from the slot

(*Continued on page* 82)

Fig. 9: Radiation patterns of the longitudinal slots in circular waveguides





IRE Convention and Radio Show

Four-day gathering in New York City, scheduled for March 19-22 will include presentation of 198 technical papers and over 260 exhibits

THE 1951 national convention of the Institute of Radio Engineers will be held March 19-22 at New York City's Waldorf-Astoria Hotel and Grand Central Palace. The technical papers program includes 43 sessions on subjects embracing virtually every branch of radio-electronics. An aggregate of 198 papers will be presented during the four days that the convention is in session and over 260 manufacturers will sponsor exhibits at Grand Central Palace. In addition, exhibits showing the latest developments in military communication systems, equipments, and components will be provided by the U. S. Army Signal Corps, U. S. Navy, and the U. S. Air Force.

Raymond Guy, IRE president in 1950 will be the toastmaster at the president's luncheon and will introduce this year's president, Ivan S. Coggeshall, general traffic manager of the Western Union Telegraph Co. Keynote of the convention will be: "Advance with Radio-Electronics in the National Emergency."

A "get-together" cocktail party is scheduled for the first evening of the convention on the Starlight Roof of the Waldorf and the annual banquet will be held on the evening of the 21st in the Grand Ballroom. An attractive program has been planned for the ladies, including sightseeing in New York, shows, and a special "Woman's Forum."

Ivan S. Coggeshall
President, Institute of Radio Engineers, 1951

TECHNICAL PAPERS PROGRAM

MONDAY, MARCH 19

Information Theory

"A Storage Tube as an Amplitude Distribution Analyzer"—R. E. Neinburg and T. F. Rogers, Air Force Cambridge Research Laboratories, Cambridge, Mass.

"Cross-Correlation and the Optimum Signal-to-Noise Ratio for Periodic Systems"—M. Leifer and N. Marchand, Sylvania Electric Products, Flushing, N. Y.

"Detection of Repetitive Signals in Noise by Correlation"—Y. W. Lee and L. G. Kraft, Massachusetts Institute of Technology, Cambridge, Mass.

"Error Reduction in the Determination of Electronic System Parameters"—L. S. Swartz, Hazeltine Electronics Corp., Little Neck, N. Y.

"Coding Processes for Bandwidth Reduction in Picture Transmission"—A. E. Laemmel, Polytechnic Institute of Brooklyn, N. Y.

Television I: Color

"Colorimetry in Color"—F. J. Bingley, Philco Corp., Philadelphia, Pa.

"Subjective Sharpness of Additive Color"—M. W. Baldwin, Bell Telephone Laboratories, Murray Hill, N. J.

"Color Multiplexing by Sine Wave Functions"—N. Marchand, Sylvania Electric Products, Inc., Flushing, N. Y.

"Measurement and Control of Color Characteristics of Flying Spot Color Signal Generator"—R. Moore, J. F. Fisher, and J. Chatten, Philco Corp., Philadelphia, Pa.

"Performance of Carrier Synchronizing Circuits for Color Television Receivers"—E. M. Creamer, Jr. and M. I. Burgett, Philco Corp., Philadelphia, Pa.

Antennas

"The Design and Use of the Automatic Antenna Pattern Recorder"—J. W. Tiley, Philco Corp., Philadelphia, Pa.

"Stagger-Tuned Loop Antennas for Wide-Band Low-Frequency Reception"—D. K. Cheng and R. A. Galbraith, Syracuse Univ., Syracuse, N. Y.

"A Theory of Concentric-Slot Antennas"—T. Morita, Cruft Laboratory, Harvard Univ., Cambridge, Mass.

"Optimum Current Distributions for Antenna Arrays with Circular Symmetry"—R. H. DuHamel, University of Illinois, Urbana, Ill.

"Directional Antenna Arrays of Elements Circularly Disposed About a Cylindrical Reflector"—R. F. Harrington, Ohio State Univ., Columbus, Ohio and W. R. LePage Syracuse Univ., Syracuse, N. Y.

Power Tubes I: Theory

"Class C Amplifier Calculations"—D W. Cawood, Sylvania Electric Corp., Emporium, Pa.

"The Effect of Secondary Emission in Power Tubes"—H. Hsu.

"Reflex Resonatron Operation and Its Implication for Bandwidth"—M. Garbury and G. E. Sheppard, Westinghouse Electric Corp., East Pittsburgh, Pa.

"The Multi-Beam Electron Coupler—An Improved Spiral Beam Electron Tube for the Modulation and Control of Power at UHF"—C. L. Cuccia, Radio Corporation of America, Princeton, N. J.

"A New Single Cavity Resonator for a Multi-Anode Magnetron"—J. S. Needle, G. Hok, C. R. Brewer, and H. W. Welch, University of Michigan, Ann Arbor, Mich.

Frequency Control and Generation

"The Generation of Single-Sideband Suppressed-Carrier Signals by a New Balancing Method"—H. M. Swarm, University of Washington, Seattle, Wash.

"Precision Frequency Generator Using Single-Sideband Suppressed Carrier Modulators"—H. R. Holloway and H. C. Harris, Sylvania Electric Products, Inc., Flushing, N. Y.

"Stabilized Variable Transmitter Exciter for Military HF Equipment"—J. Bush, Signal Corps Engineering Laboratories, Fort Monmouth, N. J.

"Wide-Range Direct-Reading Precision Frequency Meter and Signal Course"—B. Parzen, Federal Telecommunications Laboratories, Nutley, N. J.

"Crystal Control of a Four-Kilowatt 1,036-Megacycle Transmitter"—J. W. Clark, R. W. Kane, and W. G. Abraham, Varian Associates, San Carlos, Calif.

"A Frequency Stabilization System for the Measurement of Microwave Refraction of Gases"—W. F. Gabriel, Naval Research Laboratory, Washington 25, D. C.

Communication Systems

"AM-FM Analogy"—H. C. Harris, Sylvania Electric Products, Inc., Flushing, N. Y.

"Survey of Electronic Commutation Methods"—R. S. Butts, Melpar Inc., Alexandria, Va.

"High-Frequency Radio Communication System Utilizing Phase Modulator Transmission and Single-Sideband Reception"—H. F. Meyer and H. Y. Littlefield, Signal Corps Engineering Laboratories, Fort Monmouth, N. J.

"Echo Distortion in the FM Transmission of Frequency Division Multiplex"—W. J. Albersheim and J. P. Schafer, Bell Telephone Laboratories, Deal, N. J.

"Management Aspects of Electronic Systems Engineering"—R. I. Cole, Watson Laboratories, AMC, Red Bank, N. J.

TUESDAY, MARCH 20

Symposium: Amplification of DC Signals

"The Servo Modulator: A Low-Level DC Instrument"—G. M. Attura, Industrial Control Co., Long Island City, N. Y.

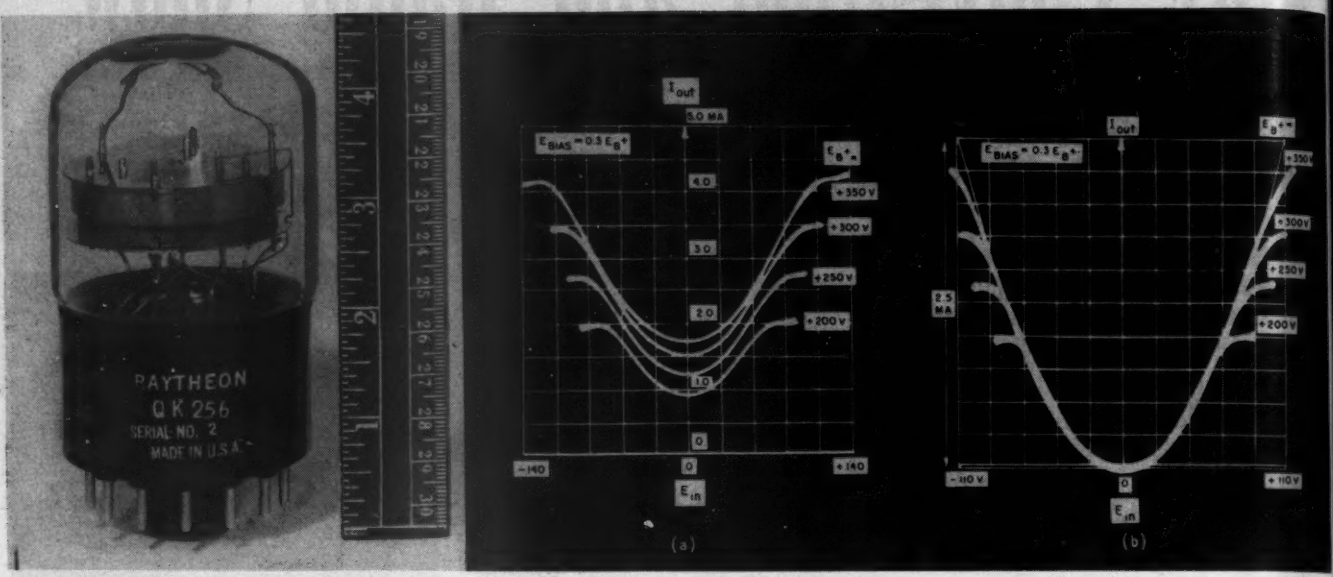
"Transient Response of Self-Saturating Magnetic Amplifiers"—E. J. Smith, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

"Direct-Current Amplifiers Employing Magnetors"—E. P. Felch, V. E. Legg, and F. G. Merrill, Bell Telephone Laboratories, Murray Hill, N. J.

"Some Aspects of Magnetic Amplifier Technique"—R. Willheim and F. E. Butcher, Electro Methods Ltd., London, England.

"Drift Compensation in DC Amplifiers for

IRE CONVENTION (Continued)



Outstanding feature of U. S. Air Force exhibit will be Square Law Tubes (types QK-256 and QK-329) Photo of tube is at left and oscilloscope photographs of static characteristic curves are at right where, (a) shows variations in absolute characteristic with plate voltage, and (b) is a comparison of curved portions of (a) with parabola. This tube performs squaring operations on zero (dc) to 40 MC signals and finds applications in linear modulators of suppressed carrier type, four quadrant multipliers of quadratic type, untuned frequency doublers, instantaneous phase meters, and square law detectors

Analogue Computors"—W. E. Ingerson, Bell Telephone Laboratories, Whippany, N. J.

Symposium: New Extensions of Network Theory

"Signal Flow Graphs"—S. J. Mason, Massachusetts Institute of Technology, Springdale, Conn.

"Some Biological Applications of Random Nets"—A. Rapoport, University of Chicago, Chicago, Ill.

"Some Effects of Communication Patterns on the Performance of Small Task Groups"—A. W. Bavelas, Massachusetts Institute of Technology, Cambridge, Mass.

"Electrical Network Models for Problems of Probability"—W. E. Bradley, Philco Corp., Philadelphia, Pa.

Symposium: Panel Discussion on Tube Reliability

Representatives from industrial users, government services, and tube Manufacturers will present their viewpoints. Chairman: E. D. Cook, General Electric Co., Schenectady, N. Y.

Power Tubes II: Development

"A Coaxial Power Triode for 50 KW Output up to 110 MC"—R. H. Rheaume, Machlett, Inc., Springdale, Conn.

"A High-Power Tetrode"—C. E. Murdock, Eitel-McCullough, Inc., San Bruno, Calif.

"The Reflex Resonatron"—G. E. Sheppard, M. Garbusy, and J. R. Hansen, Westinghouse Electric Corp., East Pittsburgh, Pa.

"Transmitting Tube Suitable for UHF Television"—W. G. Abraham, Varian Associates, San Carlos, Calif., and M. Chodorow, Stanford Univ., Calif.

"Frequency-Modulated High-Efficiency Klystron Transmitter"—M. Chodorow and S. P. Fan, Stanford Univ., Calif.

Propagation

"Selective Fading of Microwaves"—A. B. Crawford and W. C. Jakes, Jr., Bell Telephone Laboratories, Holmdel, N. J.

"Propagation Studies at Microwave Frequencies by Means of Very Short Pulses"—O. E. DeLange, Bell Telephone Laboratories, Deal, N. J.

"Low Frequency Ionospheric Soundings with Atmospherics"—W. J. Kessler and W. F. Zetrouer, II, University of Florida, Gainesville, Fla.

"The Effect on Propagation of an Elevated Atmospheric Layer of Nonstandard Refractive Index"—L. H. Doherty, Cornell Univ., Ithaca, N. Y.

Symposium: Broadcast Transmission Systems

"Master Control Facilities for a Large Studio Center"—R. H. Tanner, Northern Electric Co., Belleville, Ontario, Canada.

"Cathode-Ray Oscillography in AM, FM and

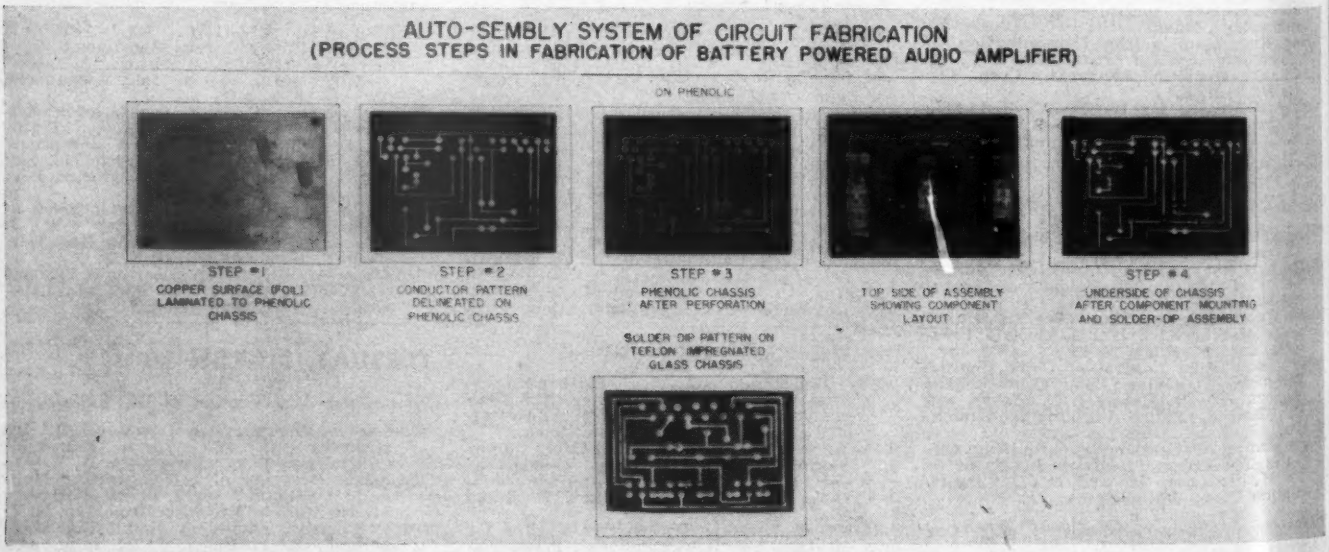

AUTO-SEMBLY SYSTEM OF CIRCUIT FABRICATION
(PROCESS STEPS IN FABRICATION OF BATTERY POWERED AUDIO AMPLIFIER)
ON PHENOLIC
STEP #1
COPPER SURFACE (FOIL) LAMINATED TO PHENOLIC CHASSIS
STEP #2
CONDUCTOR PATTERN DELINEATED ON PHENOLIC CHASSIS
STEP #3
PHENOLIC CHASSIS AFTER PERFORATION
SOLDER DIP PATTERN ON TEFLON IMPREGNATED GLASS CHASSIS
STEP #4
TOP SIDE OF ASSEMBLY SHOWING COMPONENT LAYOUT
UNDERSIDE OF CHASSIS AFTER COMPONENT MOUNTING AND SOLDER-DIP ASSEMBLY

Photo of one of the Army Signal Corps exhibits which depicts progressive steps in the fabrication of a battery powered audio amplifier using the Auto-Sembly system of printed circuitry. Other exhibits will show the Video-Phone, two-way aural and visual communications; badge and pocket atomic radiation dosimeters, "G" string RF transmission; delayed speech feedback equipment; radio component miniaturization, improved materials and construction; new vacuum tubes and thermionic devices

TV Broadcasting"—P. S. Christaldi, Allen B. DuMont Laboratories, Inc., Passaic, N. J.
"Optimum Performance of Sectionalized Broadcast Towers"—C. E. Smith, United Broadcasting Co., Cleveland 13, Ohio.
"Increased Economy and Operating Efficiency of Television Broadcast Stations Through Systemic Design"—R. A. Isberg, KRON-TV, San Francisco, Calif.
"Technical Considerations of Television Broadcasting"—G. E. Hamilton, American Broadcasting Co., New York City.

Symposium: Panel Discussion on Performance of DC Amplifiers

A panel qualified to discuss design, performance and application aspects of dc amplifiers of many types will present brief prepared remarks. Following this the audience will be invited to participate with questions and comments aimed at bringing out the capabilities of existing designs and the problems still requiring solution.
Chairman: Ernst Weber, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Symposium: Matching Schools and Industry

"Educational Requirements for Development Engineers in Electronic and Communication Technology"—M. J. Kelly, Bell Telephone Laboratories, New York City.
"Making Engineering Education Professional"—B. R. Teare, Carnegie Institute of Technology, Pittsburgh 13, Pa.
"Using Tests to Select Engineers"—W. G. Findley, Educational Testing Service, Princeton, N. J.
"Orienting the Engineer in Industry"—E. W. Butler, Federal Telephone and Radio Corp., Clifton, N. J.

Circuits I: Synthesis and Analysis

"Network Synthesis Applied to Feedback Control"—J. G. Truxal, Purdue Univ., Lafayette, Ind.
"Network Synthesis by Use of Potential Analogues"—R. E. Scott, Massachusetts Institute of Technology, Cambridge, Mass.
"Transfer Ratio Synthesis by RC Networks"—J. T. Fleck, Cornell Aeronautical Laboratory, Buffalo, N. Y., and P. F. Ordung, Yale Univ., New Haven, Conn.
"Electro Mechanical Equivalent Network Synthesis"—A. E. Gerlach, Illinois Institute of Technology, Chicago 16, Ill.
"Linear Network Neighborhood Equivalence"

(*Continued on page* 66)

EXHIBITORS AT GRAND CENTRAL PALACE

Ace Engineering & Machine Co., 3642 N. Lawrence St., Philadelphia 40, Pa.
Aerovox Corp., 740 Belleville Ave., New Bedford, Mass.
Aircraft-Marine Products Co., 1521-31 N. 4th St., Harrisburg, Pa.
Airtron, Inc., 101 E. Elizabeth Ave., Linden, N. J.
Alden Products Co., 117 N. Main St., Brockton, Mass.
Alfax Paper & Engineering Co., 45 Riverside Ave., Brockton, Mass.
Allied Control Co., Inc., 2 East End Ave., New York 21, N. Y.
Alpha Metals, Inc., 363 Hudson Ave., Brooklyn, N. Y.
Altec-Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif.
American Lava Corp., Chattanooga, Tenn.
American Phenolic Corp., 1830 S. 54th Ave., Chicago 50, Ill.
American Structural Products Co., Ohio Bldg., Toledo, Ohio
American Television & Radio, 300 E. 4th St., St. Paul 1, Minn.
Amperex Electronic Corp., 79 Washington St., Brooklyn, N. Y.
Andrew Co., 376 E. 75th St., Chicago, Ill.
Anton Electronic Laboratory, 1226 Flushing Ave., Brooklyn 6, N. Y.
Arnold Engineering Co., Post Office Box G, Marengo, Ill.
Atomic Instrument Co., 160 Charles St., Boston, Mass.
Audio Devices, Inc., 444 Madison Ave., New York, N. Y.
Automatic Electric Sales Co., 1026 W. Van Buren St., Chicago, Ill.
Avion Instrument Corp., 15 Moore St., New York 4, N. Y.

Ballantine Laboratories, Inc., Boonton, N. J.
Barker & Williamson, 235 Fairfield Ave., Upper Darby, Pa.
The Barry Corp., 179 Sidney St., Cambridge, Mass.
Bendix Aviation Corp., Baltimore, Md.
Berkeley Scientific Co., 6th and Nevin Aves, Richmond, Calif.
Bird Electronic Corp., 1800 E. 38th St., Cleveland, Ohio
Bliley Electric Co., Union Station Bldg., Erie, Pa.
Boesch Mfg. Co., 45 River St., Danbury 32, Conn.
Boonton Radio Corp., Boonton, N. J.
Geo. W. Borg Co. (Gibbs Div.), Delavan, Wisc.
W. H. Brady Co., 204 W. Washington St., Milwaukee, Wisc.
Brentano's Technical Dept., New York, N. Y.
British Industries Sales Corp., 164 Duane St., New York, N. Y.
Brooks & Perkins, Inc., 1950 W. Fort St., Detroit 16, Mich.
Browning Labs, Inc., 750 Main St., Winchester, Mass.
Brujac Electronic Corp., 103 Lafayette St., New York, N. Y.
Brush Development Co., 3405 Perkins Ave., Cleveland 14, Ohio
Burlington Instrument Co., 1102 Fourth St., Burlington, Iowa
Bussmann Mfg. Co., University at Jefferson St. Louis 7, Mo.

Caldwell-Clements, Inc., 480 Lexington Ave., New York, N. Y.
The Calidyne Co., 751 Main St., Winchester, Mass.
Cambridge Thermionic Corp., 445 Concord Ave., Cambridge, Mass.
Camloc Fastener Corp., 420 Lexington Ave., New York 17, N. Y.
Cannon Electric Development Co., 3209 Humboldt St., Los Angeles 31, Calif.
Capitol Radio Eng'g. Inst., Washington, D. C.
Carboloy Co., Inc., 11177 E. Eight Mile Rd., Detroit 32, Mich.
Carter Motor Co., 2644 N. Maplewood Ave., Chicago, Ill.
Centralab Div., Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wisc.
Century Geophysical Corp., Tulsa, Okla.
C. G. S. Laboratories, Stamford, Conn.
Chicago Rivet & Machine Co., 9600 W. Jackson, Bellwood, Ill.
C. P. Clare & Co., 4719 W. Sunnyside, Chicago, Ill.
Clarostat Mfg. Co., Inc., Dover, N. H.
Cleveland Container Co., 6201 Barberton Ave., Cleveland, Ohio
Sigmund Cohn, 44 Gold St., New York, N. Y.
Coil Winding Equipment Co., 37 West Main St., Oyster Bay, N. Y.
Collins Radio Co., 855—35th St., N. E., Cedar Rapids, Iowa
Communication Products Co., Inc., P. O. Box 233, Keyport, N. J.
Condenser Products Co., 1375 N. North Branch, Chicago, Ill.
Consolidated Engineering Corp., 620 N. Lake St., Pasadena 4, Calif.
Continental Carbon, Inc., 13900 Lorain Ave., Cleveland, Ohio
Continental Electric Co., 715 Hamilton St., Geneva, Ill.
Cornell-Dubilier Electric Corp., 1006 Hamilton Blvd., So. Plainfield, N. J.
Corning Glass Works, Corning, N. Y.
Cosser (Canada) Ltd., Windsor St., Halifax, N. S., Canada
R. W. Cramer Co., Inc., Centerbrook, Conn.

The Daven Co., 191 Central Ave., Newark 4, N. J.
Bryan Davis Publishing Co., 99 Hudson St., New York, N. Y.
Dial Light Co. of America, Inc., 900 Broadway, New York 3, N. Y.
Distillation Products Industries, Rochester 3, N. Y.
Wilbur B. Driver Co., 150 Riverside Drive, Newark, N. J.
Allen B. Dumont Lab., Inc., East Patterson, N. J.
Dumont Electric Co., 308 Dyckman St., New York 34, N. Y.
DX Radio Products Co., 2300 W. Armitage Ave., Chicago, Ill.

Hugh H. Eby, Inc., 4700 Stenton Ave., Philadelphia, Pa.
Eastern Air Devices, Inc., 585 Dean St., Brooklyn 17, N. Y.
Eitel-McCullough, Inc., San Bruno, Calif.
Electrical Industries, Inc., 42 Summer Ave., Newark 4, N. J.
Electrical Reactance Corp., Seneca Ave., Olean, N. Y.
Electronic Associates, Inc., 61 Brighton Ave., Long Branch, N. J.
Electronic Instrument Co., 276 Newport St., Brooklyn, N. Y.
Electronics Measurements Lab., Lewis and Maple Sts., Eatontown, N. J.
Electronic Mechanics, Inc., 70 Clifton Blvd., Clifton, N. J.
Electronic Tube Corp., 1200 E. Mermaid Ave., Chestnut Hill, Philadelphia, Pa.
El-Tronics, Inc., 2647 N. Howard St., Philadelphia, Pa.
Empire Devices, Inc., 161 Maiden Lane, New York 7, N. Y.
Erie Resistor Corp., 644 W. 12th St., Erie, Pa.

Fairchild Camera & Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N. Y.
Fairchild Recording Equipment Corp., 154th and 7th Ave., Whitestone, L. I., N. Y.
Federal Telecommunication Labs., Inc., 500 Washington Ave, Nutley, N. J.
Federal Telephone & Radio Co., 100 Kingsland Rd., Clifton, N. J.
Federated Metals Div., American Smelting Co., Whiting, Ind.
Ferris Instrument Corp., 110 Cornelia St., Boonton, N. J.
Filtron Co., Inc., 38-25 Bell Blvd., Bayside, N. Y.
Fisher Radio Corp., 39 E. 47th St., New York, N. Y.
Ford Instrument Co., Inc., 31-10 Thompson Ave., Long Island City 1, N. Y.
Freed Transformer Co., 1718-36 Weirfield St., Brooklyn, N. Y.
Furst Electronics, 800 W. North Ave., Chicago, Ill.

Gates Radio Supply Co., 123 Hampshire St., Quincy, Ill.
General Ceramics & Steatite Corp., Keasbey, N. J.
General Electric Co., Electronics Park, Syracuse, N. Y.
General Precision Laboratory, Inc., 63 Bedford Rd., Pleasantville, N. Y.
General Radio Co., 275 Massachusetts Ave., Cambridge, Mass.
John Gombos & Co., Inc., 103 Montgomery Ave., Irvington 11, N. J.
Gray Research & Development Co., 521 Fifth Ave., New York, N. Y.
Green Instrument Co., 385 Putnam Ave., Cambridge, Mass.
Guardian Electric Mfg. Co., 1627 Walnut St., Chicago 7, Ill.

A. W. Haydon Engineering Co., 111 W. Main St., Waterbury, Conn.
Haydu Bros., Plainfield, N. J.
Heiland Research Corp., 130 E. 5th Ave., Denver 9, Colo.
Helipot Corp., 1011 Mission St., S. Pasadena, Calif.
Hermatic Seal Products Co., 29-37 S. 6th St., Newark, N. J.
Hewlett-Packard Co., 481 Page Mill Rd., Palo Alto, Calif.
Hickok Electrical Instrument Co., 10516 Dupont Ave., Cleveland, Ohio
Hytron Radio & Electronics Corp., 76 Lafayette St., Salem, Mass.

Indiana Steel Products Co., Valparaiso, Ind.
Industrial Electronics, Inc., 21 Henry St., Detroit 1, Mich.
Industrial Products Co., Danbury, Conn.
Instrument Specialties Co., 236 Bergen Blvd., Little Falls, N. J.
Instruments Publishing Co., 921 Ridge Ave., Pittsburgh 12, Pa.
International Nickel Co. 67 Wall St., New York 5, N. Y.
International Resistance Co., 401 N. Broad St., Philadelphia, Pa.

J-B-T Instruments, Inc., 441 Chapel St., New Haven, Conn.
J. F. D. Mfg. Co., 6101 16th Ave., Brooklyn 4, N. Y.
Howard B. Jones Div., Cinch Mfg. Co., 1026 S. Homan Ave., Chicago 24, Ill.

Kalbfell Laboratories, Inc., 1076 Morena Blvd., San Diego, Calif.
Karp Metal Products Co., Inc., 211—63rd St., Brooklyn, N. Y.
Kay Electric Co., Pine Brook, N. J.
The Kelley-Koett Instrument Co., 930 York St., Cincinnati, Ohio
Kenyon Transformer Co., Inc., 840 Barry St., New York 59, N. Y.
Kester Solder Co., 4201 Wrightwood Ave., Chicago, Ill.
Ketay Mfg. Corp., 18 West 20th St., New York, N. Y.
Kings Electronics, Inc., 811 Lexington Ave., Brooklyn, N. Y.
James Knights Co., Sandwich, Ill.
Kulka Electric Mfg. Co., 30 South St., Mt. Vernon, N. Y.
Kupfrian Mfg. Co., 218 Prospect Ave., Binghamton, N. Y.

James B. Lansing Sound, Inc., 2439 Fletcher Dr., Los Angeles 39, Calif.
LaPointe-Plascomold Corp., 37 Mill St., Unionville, Conn.
Lavoie Laboratories, Morganville, N. J.
Leach Relay Co., 5915 Avalon Blvd., Los Angeles 3, Calif.
Linde Air Products Co., 30 E. 42nd St., New York, N. Y.
Littlefuse, Inc., 4757 Ravenswood Ave., Chicago 40, Ill.
Lord Mfg. Co., 1635 W. 12th St., Erie, Pa.

McIntosh Engineering Lab., 910 King St., Silver Spring, Md.
Machlett Labs., Inc., Hope St., Springdale, Conn.
Magnecord, Inc., 360 N. Michigan Ave., Chicago, Ill.
MB Mfg. Co., 1080 State St., New Haven 11, Conn.
P. R. Mallory & Co., 3029 E. Washington St., Indianapolis 1, Ind.
Mfrs. Thread Grinding Co., P. O. Box 66, Eatontown, N. J.
Marconi Instruments, Ltd., 25 Beaver St., New York 4, N. Y.
Marion Electrical Instrument Co., Manchester, N. H.
W. L. Maxson Corp., 460 W. 34th St., New York 1, N. Y.
Measurements Corp., 116 Monroe St., Boonton, N. J.
Mepco, Inc., 37 Abbott Ave., Morristown, N. J.
Microwave Equipment Co., Inc., Greenbrook Rd., N. Caldwell, N. J.

(*Continued on page* 99)

CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

Edited by John H. Battison

Speed Check for Tape Recorders

ROBERT K. COBB, Chief Engineer, KSBW, Salinas, California

BECAUSE there are no commercially available instruments or stroboscopes to adjust tape or wire recorders to correct speed the KSBW Engineering Department went to work and came up with the following system:

All that is needed is an oscilloscope and an audio oscillator, items found in most broadcasting stations.

When a new magnetic recorder is purchased (or while it is still operating like new) a five or ten minute recording is made of a sine wave from the audio oscillator. We used a 1000 cycle tone because it is in the approximate center of the recorder's frequency response. If the recorder's speed is thought to have changed after a period of use it can be checked by playing back the test recording.

The output of the recorder is fed into the vertical amplifier input of an oscilloscope. An audio oscillator is connected to the horizontal input. The audio oscillator should, of course, be very carefully set to the same frequency as the one used to make the test recording. In this case 1000 cps. With this set-up a Lissajous figure showing a ratio of 1:1 (simple circle) will be produced if the playback speed is correct. By adjustment of the several mechanical parts (brakes, springs, idlers, capstan, heads, etc.) it should be possible to produce a circle. When this is done the recorder is operating at the original speed.

A simple substitute for the audio oscillator if it is not available is a 60 cycle sine wave from the AC line obtained through a 10,000 ohm, ½ watt resistor connected in series with a filament winding of a small power transformer.

Output Balancing Control

C. J. AUDITORE, TV Facilities Engineer, WOR-TV, New York City

The synchronizing generator is the heart of every television installation, and it is advisable that a standby be provided. A simple sync generator selector switch facilitates emergency changeover from one unit to the other.

$$$ FOR YOUR IDEAS

Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Typewritten, double-spaced text is preferred. Our usual rates will be paid for material used.

Manufacturers provide for matching sync generators in every respect except one, namely, the individual pulse voltage amplitudes. Owing to the various shaping processes to which the pulses are subjected and the many control functions which they perform, a marked change in the picture output results when switching between unbalanced sync generators. This necessitates a rapid readjustment of the camera controls for program continuity.

The manufacturer specifies that the output pulses will have a peak to peak voltage of between 3.5 and 5.0 volts across a 75 ohm load. It is impossible to fix the voltage amplitude at one specific value because of tolerances and other variations in circuit parameters including the 6AG7 output tubes, the characteristics of which change with ageing. Therefore, some sort of an output balancing control is required to match pulses. The accompanying diagram shows the changes required to provide output balancing controls on the TG-1A Synchronizing Generator. Complete modification can be accomplished in a few hours, and a uniform output of 4 volts, peak to peak across 75 ohms is readily obtained.

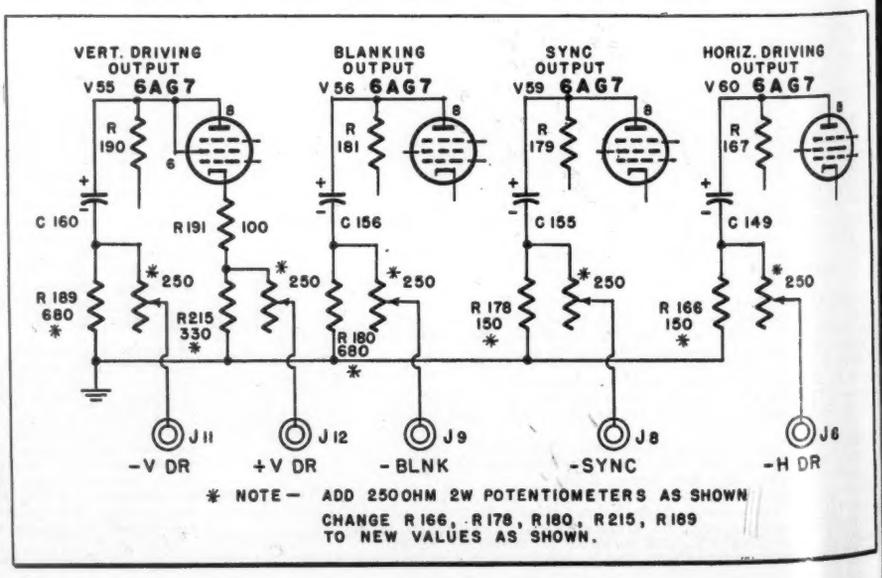
Additional balancing controls may be provided on the remaining outputs if desired, but these are not critical in the normal television system. The same modification may be applied to the field sync generators, using similar circuit values. A rack mounted type sync generator switch is commercially available. If desired, a homemade switch may be constructed. The switch should be wired-up to terminate the generator outputs in either a dummy 75 ohm termination, or the normal equipment load.

Resistor Isolation

R. S. HOUSTON, 18 Oak Lane, Haverstown, Pa.

A resistor can be used in place of an isolation amplifier, with restrictions, to feed a monitoring circuit or other bridging device. Provided there is no danger that foreign programs may leak back into the program line from the monitoring line, a 1000 ohm resistor can provide protection for the program line against accidental short circuits on a monitoring line to offices, etc. Where speakers are likely to be moved, and the line shorted, the short will merely place a 1000 ohm load on the program line. This

Modifications to TG-1A studio sync. generator to provide balanced changeover



will change the level less than two DB. While it might be noticeable if one were listening for it, the average listener would not hear it. The value is low enough so that it will not attenuate the speaker level greatly, thus permitting lower gain amplifiers to be used. Of course a higher resistance could be used, with less interaction noticeable, but 1000 ohms has proved sufficient.

Bill Sykes to the Rescue!

WHEN WMAR-TV had a remote pickup to do from a bowling alley they found it necessary to cut through a metal plate in the building rear to pass cables. When the field crew arrived to cut the hole they found an enterprising burglar had beaten them to it and smashed the plate right out of the wall. This, probably, is the first time crime has aided television!

Local Sync for Self-Winding Clocks

AL PRATT, Chief Engineer, WANS, Anderson, S. C.

IN many broadcast station locations, especially transmitter plants located in rural areas, synchronization service for self-winding clocks is difficult to obtain.

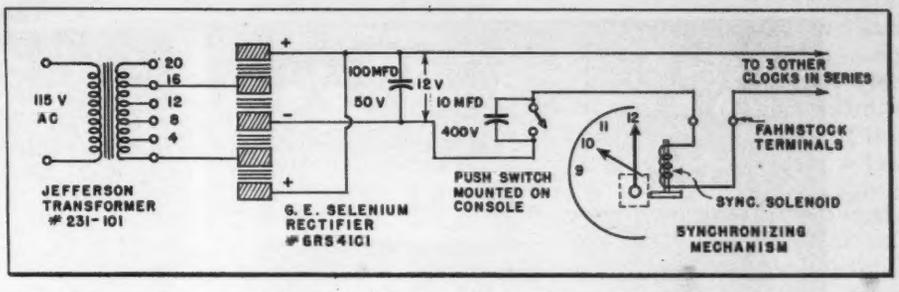
A satisfactory solution to this problem was worked out at WANS. Four sixteen-in. self-winding type synchronizing clocks were purchased. These were installed in the two studios, control room and program office.

With the sync terminals of these clocks connected in series, a 12 volt dc potential is applied through a push-switch conveniently located near the operating console. Time signals from WWV or network cues are used as accurate standards.

Depressing the synchronizing button places voltage across the series connected solenoids, as shown below, positioning the minute and sweep second hands precisely at 12. Simultaneously the hour hand is brought into alignment with the indicated hour. Many sync-clocks also incorporate a signal lamp, which is illuminated when the synchronization mechanism is activated.

It was found necessary to place an electrolytic capacitor (10 μf, 400 v.) across the push-switch to eliminate the transmission of noise, caused by sparking in the contacts.

On installation of this system, it is advisable to regulate each clock, by adjusting the pendulum thumb screw. In this manner, one second per hour accuracy can easily be obtained by mechanical means alone.



Power supply and circuit details of automatically synchronized local clocks

Important to note is that a limit in the sync mechanism of these clocks requires that the minute hand be within two minutes, and the sweep second hand, within twenty seconds of 12 (or 60), otherwise the sync feature is inoperative. (12 v. dc with a one amp. capacity is required.) The power supply used at WANS has been satisfactory and trouble-free for nearly two years of service.

Muting Microphone Switches

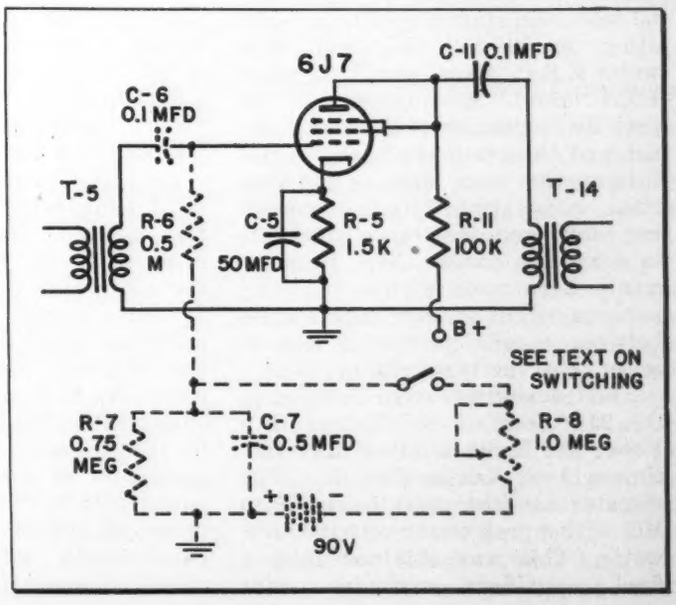
MARVIN L. PAUL, Chief Engineer, WATO, Oak Ridge, Tenn.

MUCH has been said about trouble with a microphone switch which slipped out of adjustment so that the control room mike picks up the clacking of the associated speaker muting relay when the mike is energized. Even more bothersome, because he can talk back, is the "switch-slapping" announcer working from the control room sound like "The Anvil Chorus".

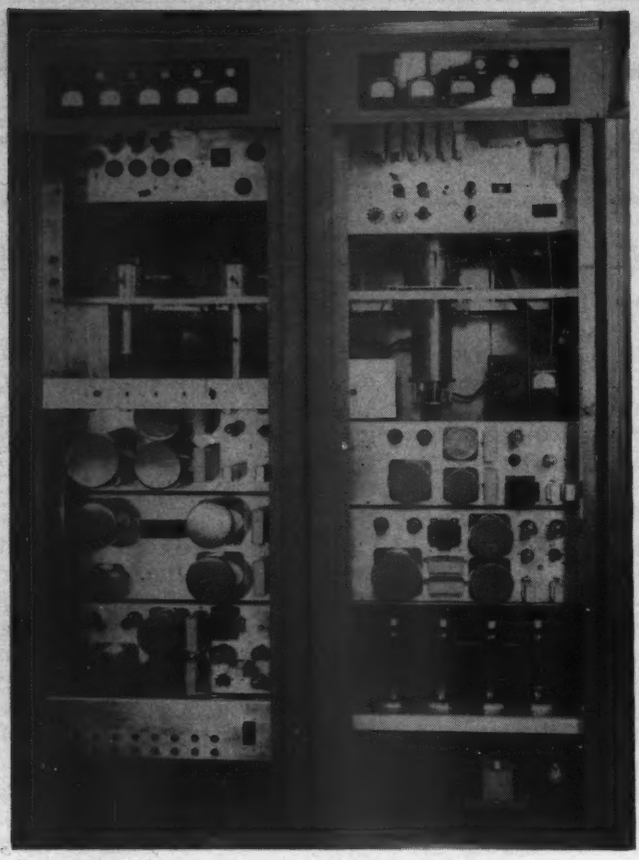
Here is how the problem was solved at WATO. First, we dug out the offensive speaker muting relays and reinstalled them inside the console. After apologizing to the announcers for having nagged them for months about banging the control room mike switch, we garnered a spare muting relay, a couple of condensers, two resistors, a potentiometer, and a ninety volt battery. With these parts we rigged the pre-amp of the mike so that it was biased beyond cutoff for a fraction of a second after the mike switch was thrown on.

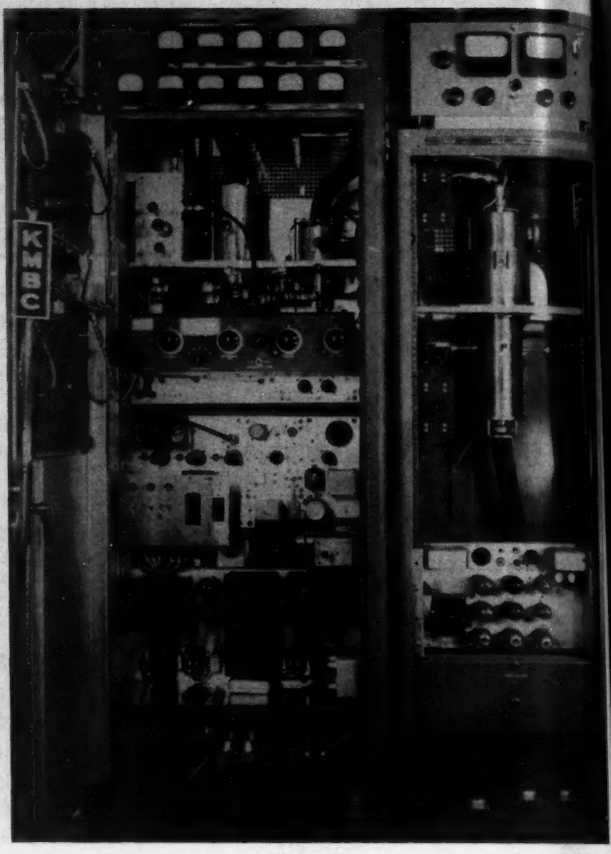
Referring to the diagram: when the mike is off the pre-amp grid is biased to about -45 volts. When the mike is turned on the battery is disconnected and the blocking voltage discharges through R-7 C-7. When the voltage decays below cutoff the pre-amp is operative. R-8 affords convenient control of the inoperative time. The spare relay serves to switch off the blocking voltage. Its coil is wired in parallel with the speaker muting relay normally operated by the control room mike switch.

Although the console in this case is a Raytheon RC-11, the circuit should be applicable to most consoles. With R-8 at half scale we get a one second delay. Switching noise is eliminated entirely. Another good feature of this unit is that due to the fact that the pre-amp gain rises exponentially after the mike is turned on, the high level background noise common to so many control rooms comes in so gradually that it is hardly noticeable to the listener.



Raytheon RC-11 Console, Mic. input #5 modified to provide muting for microphone switches to prevent the microphone from opening too soon and picking up noise





UHF TV Propagation

Comprehensive survey under typical broadcasting conditions using both commercial receivers and field strength measuring equipment provides new angles on UHF TV

DURING April and May, 1950 an ultra high frequency TV survey was made at Kansas City, Mo., utilizing the transmissions of experimental television station KA2XAQ, operating on 506-512 MC, with 3450 watts E.R.P. visual and 1725 watts E.R.P. aural. Measurements of the peak field intensity of the visual signal, and observations of relative picture quality, were made at 130 locations, lying along 7 radials extending south from the transmitting site in downtown Kansas City. Measurements were made with a receiving antenna height of 20 ft. at distances between approximately 1.5 and 25 miles from the transmitting site.

The transmitters were installed on the 31st floor of the Kansas City Power and Light Building, 1330 Baltimore Ave., Kansas City, Mo. The visual transmitter operated on 507.25 MC, with a peak power output of 500 watts. This was obtained from a final amplifier employing four 4X150-A tetrodes operating essentially in parallel in a cavity circuit. The amplifier was grid modulated by one 4X150-A operating as a cathode follower. The aural transmitter operated on 511.75 MC, with a power output of 250 watts, obtained from a final amplifier similar to that of the visual transmitter, but employing two 4X150-A tetrodes.

Separate, identical, corner reflector antennas were employed for both transmitters. These antennas were mounted on the 32d floor balcony on the south side of the building, 400 ft. above ground level, and 1270 ft. above sea level. Horizontal polarization was used and the transmission lines were 33-ft. lengths of RG-17/U, 50 ohm cable. Specifications furnished by the Andrew Co., of Chicago, Ill., developers of the antennas, give a power gain in the direction of maximum radiation of 9.2 db, and a total beam width between half power points of approximately 60 degrees in both vertical and horizontal planes.

Radiated powers of 3450 watts peak visual and 1725 watts aural were obtained as follows:

	Power (db above 1 KW) Visual	Aural
Transmitter power output	–3.0 db (peak)	–6.0 db
Transmission line loss	0.8 db	0.8 db
Power delivered to antenna	–3.8 db (peak)	–6.8 db
Antenna power gain	9.2 db	9.2 db
Radiated power	5.4 db (peak)	2.4 db

These powers apply to all measurements, since the directional transmitting antennas were re-oriented for each radial as measurements were made. The transmitters were modulated by test patterns and tone signals during the tests.

The receiving equipment consisted of an ultra-high-frequency converter operating into a Zenith Model 281926EU television receiver. After preliminary tests at several receiving locations, an RCA converter,

Fig. 3: (left) Transmitting antenna mounted on Power and Light Building. Note size.

Fig. 4: (below) Five-element Yagi used for all the measurements.

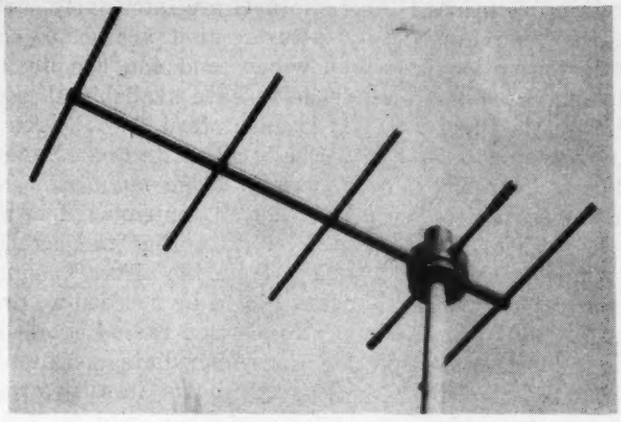


Fig. 1 (far left) The visual transmitter which was constructed around the old FM equipment.

Fig. 2: (left) Aural transmitter utilized similar cavity in final stage employing 2 tubes.

Measurements

PART ONE OF TWO PARTS

By KENNETH H. COOK, Research Engineer
ROBERT G. ARTMAN, Chief Television Engineer*
Midland Broadcasting Co., Kansas City, Mo.

identical with those used by the National Broadcasting Co. in the Bridgeport, Conn. ultra-high-frequency tests, was chosen for the measurements, principally because of the ease of tuning provided by this model. This converter incorporates a G-7 crystal mixer, a 6J6 local oscillator operating below input signal frequency, and a 3 tube intermediate frequency amplifier with a 12 MC bandwidth centered on channel 12. A 300-ohm balanced output is provided for connection to a standard television receiver.

The dc voltage developed by the automatic gain control system of the Zenith receiver was measured by a Hewlett Packard Model 410-A Vacuum Tube Voltmeter as an indication of field intensity. This voltage is proportional to the peak value of the visual signal voltage at the input terminals of the receiver, or at the input terminals of a converter employed in conjunction with the receiver, when the visual signal is modulated with standard synchronizing pulses. The field intensity indication was therefore independent of the degree of modulation at the visual transmitter. Calibration of the converter-receiver combination is described later.

Before the start of the measurements, various receiving antennas were constructed and tested at several locations, ranging from well above, to well below, optical line of sight, at distances of 4.5 to 8.6 miles from the transmitters. They are:

Fan dipole
Yagi (Five element surplus model, specified frequency range, 450-560 MC)
Rhombic, 2 wavelengths/leg
Rhombic, 3 wavelengths/leg
2 stack Rhombic, 2 wavelengths/leg
4 stack Rhombic, 2 wavelengths/leg
Corner reflector (identical to transmitting antennas).

Comparative tests of their antennas, matched to transmission lines of similar attenuation, were made with an RCA Model A Converter, used in conjunction with the Zenith receiver. Since no calibration of this receiving system was made, actual realized gain figures are not available for these antennas, except in the case of the Yagi. The gain of this antenna was later determined to be 6.3 db over a reference dipole. However, the Yagi and the 2 stack Rhombic each provided the highest value of receiver automatic gain control system voltage at several receiving locations, and gave identical, highest values at several other locations. The performance of the other Rhombic antennas was not consistent, but was in general below that of the 2 stack Rhombic. The Corner reflector and Fan Dipole yielded the poorest results at all locations; the Corner reflector being better than the Fan dipole in all cases except one. It will be noted that the *theoretical gain figures* of the various antennas were *not generally realized*, as has been reported by other observers. This is particularly true in the case of the Rhombic antennas; none of which exceeded 6.3 db gain in any of the tests.

The Yagi antenna was chosen over the 2 stack Rhombic for use in the measurements, because of its ease of handling. A 50-ft. length of RG-11/U, 70 ohm cable was employed with the Yagi for all measurements. The attenuation of this cable was 2.5 db. A 4 section steel pole was used to raise the antenna to a height of 20 ft. at each location.

Receiving and measuring equipment was mounted in a DeSoto Suburban, which also carried the antenna, transmission line, and pole. Power was obtained from a gas-engine driven generator, in a trailer drawn by the Suburban.

Calibrating Measuring Equipment

The converter-receiver combination employed in the field intensity measurements was calibrated by means of a Hewlett Packard Model 610-B Signal Generator. In order to ensure accurate tuning of the converter and signal generator, visual and aural signals from an antenna were applied to the converter input, and the converter was properly tuned as indicated by a dc voltmeter connected across the output of the sound discriminator in the receiver. The output cable of the signal generator was then placed in the vicinity of the converter input, and the signal generator tuned to zero beat with

(*Continued on page* 92)

*Now television engineer for American Broadcasting Co., New York City

WASHINGTON
News Letter

Latest Radio and Communications News Developments Summarized by TELE-TECH's Washington Bureau

MARCHING ORDERS FROM TOP COMMAND—The nation's electronics-radio manufacturing industry—and its engineering talent, production executives and research laboratories—has got its "marching orders" from the highest commanders in the national defense mobilization—President Truman, the Commander-in-Chief, and former General Electric President Charles E. Wilson, the extremely competent Director of War Mobilization. Our field of electronics and radio is placed as one of the most important of the military equipment requirements by both of the United States leaders—we rank with guided missiles, atom bombs, airplanes and tanks in the category of the most important combat weapons. Mr. Wilson, whose GE industrial experience has given him a comprehensive knowledge of the electronic and radio fields in broad production planning, stated in one of his few addresses that far greater quantities of electronics-radio equipment are needed in the present mobilization than in World War II and Mr. Wilson stressed "they are needed sooner." President Truman declared in his Budget Message that for military electronics-radio apparatus and equipment as well as planes, tanks, rockets, etc., "this means a major production effort in order to obtain the best and most modern equipment for our enlarged active forces and for large reserve stocks."

AIR FORCE EQUIPMENT CATEGORIES—The broad categories of equipment in the contracts, virtually completed with the manufacturers by March 1 in the $854 million funds for electronics-radio equipment of the Air Force were the following: airborne electronics equipment for the new airplanes under manufacture, including radio compasses, fire-control and bombing radar, altimeters, and command radio communications equipment—$370 million; modernization of equipment in present airplanes and at airfields—$398 million; conversion of existing equipment, both airborne and ground, from VHF to UHF, and airborne and ground point-to-point communications and airborne and ground electronic navigational systems, such as GCA, ILS, and Loran, and the air defense radar network, including the equipment, land and buildings—$468 million; and logistical support, communications and electronics equipment—$86 to $95 million.

AIRCRAFT MANUFACTURERS GET ONLY 5%—In view of the goal of 50,000 airplanes a year which means their equipping with most modern electronic and radar devices and the $2.5 billion expansion and modernization of the Fleet, both the Air Force and the Navy procurement services in the electronics-radio field are intensively surveying all available manufacturers that are competent and have engineering know-how and can comply with firm delivery dates so as to have available all sources of supply possible. It is understood that the Air Force has now lined up virtually all of its needed manufacturing concerns, including a large number of new manufacturers that have not so far engaged in military procurement. It is imperative that the accelerated deliveries of airplanes from the aircraft manufacturing companies be accompanied by speeded-up production and delivery of electronics and radio apparatus so as to place the new planes in immediate operation, and similarly the Navy needs equipment in rush order for the ships "taken out of mothballs" and for the new vessels under construction. Contrary to some published reports, it was understood that only 5 percent of the total Air Force electronic procurement would go to aircraft manufacturing companies and virtually all of that will be placed with one manufacturer (understood to be the Hughes company) for the production of electronic items in guided missiles and proximity fuses.

MOBILE SERVICES IMPORTANT—As has been emphasized by TELE-TECH, mobile radio communications systems will be highly important in the civil defense activities and in the general national defense mobilization, and manufacturing is extremely likely to be kept up substantially, despite the growing shortages of critical materials and metals. The Civil Defense Administration and the FCC have been working in close liaison in the planning of the functioning of the various mobile radio services. The FCC is already engaged in drafting the necessary rule changes and clarifications of existing rules to provide for the CDA program. The Power Utility and Petroleum Radio Services are expected to be loaded with their own operational traffic in event of civil defense emergencies, while the police and fire services, of course, and non-government like taxicab, domestic public and bus and truck systems will be relied upon heavily for mobile radio communications in time of civil defense emergencies. The amateur radio operations will also be a most important part and ten frequency bands have been established for approved "ham" civil defense operations.

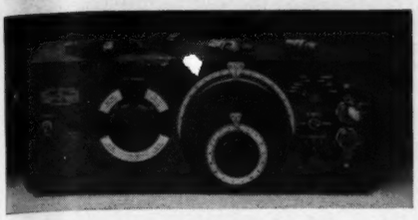
National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington, Editor

NEW EQUIPMENT for Designers and Engineers

Bridge Oscillator

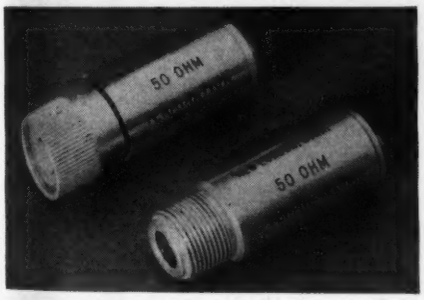
Type 1330-A bridge oscillator is a compact, stable, variable-frequency source of moderate power output. It has been de-



signed for use in antenna and bridge measurements. Three audio frequencies (power line, 400, and 1000 cps) and a wide continuous range of r-f from 5 KC to 50 MC, either modulated or unmodulated, are provided. Output voltage is of the order of 10 v. and more than 1 watt can be delivered into a 50-ohm load over most of the frequency range. Two levels of internal modulation at either 400 or 1000 cps are available over the range from 15 KC to 50 MC. Compared to its prewar counterpart, the type 1330-A is 11 lbs. lighter, has approximately one-half the volume and one-half the input power needs, yet covers a wider frequency range and supplies about 10 times the output, power at a lower impedance level.—**General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.**—TELE-TECH

Coaxial Line Terminations

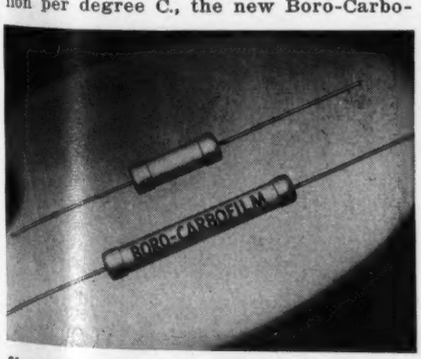
Model F-50 (female fitting) and M-50 (male fitting) coaxial line terminations are 50-ohm units featuring low standing



wave ratios from dc to over 3000 MC. They are useful for rapid overall tests of slotted lines, cables, r-f bridges, sweep generators, and random noise sources. Maximum VSWR is 1.05 to 3000 MC. Fittings are type N.—**New London Instrument Co., P. O. Box 189, New London, Conn.**—TELE-TECH

Resistor

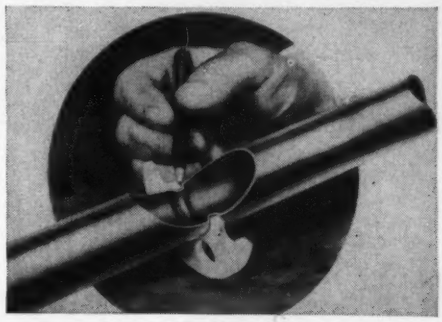
With their small ageing and low temperature coefficient of 20 parts per million per degree C., the new Boro-Carbo-



film resistors are ideal for high frequency communication applications. They are manufactured under license arrangement with Western Electric and are available in ¼, ⅓, ½, 1 and 2 watt sizes.—**Wilkor Products, Inc., 2882 Detroit Ave., Cleveland 13, Ohio**—TELE-TECH

Transmission Line

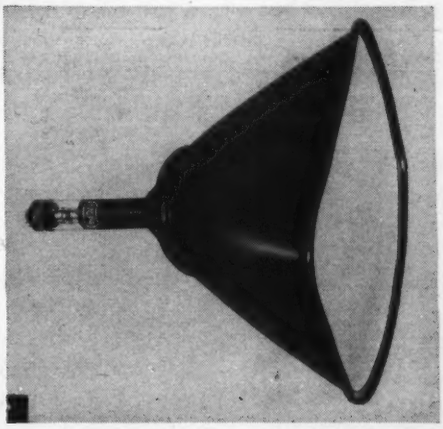
Production of a new Seal-O-Flange super efficient transmission line for FM, television and other services using increasingly high frequencies has been announced. Incorporating Dupont Teflon for insulation, the new CP transmission line permits operation at frequencies previously impossible because of effective power loss in lines utilizing insulators of high dielectric loss. It is available in three standard sizes: ⅞ in., 1⅝ in., and 3⅛ in. With the exception of gas stops and elbows, this CP transmission line is interchangeable with all other CP fittings including end seals, tower hardware, flanges, "O" rings, inner conductor connectors and miscellaneous accessories. inner connector made of a single piece of copper tubing. Teflon discs are locked in Construction features include a one-piece place in the inner conductor in order to provide positive, permanent positioning. Cutaway view shows the copper inner



conductor of a small section of the line. The one-piece insulating disc fits into a depression formed in the tube wall to prevent movement. — **Communication Products Co., Broadway and Clark St., Keyport, N. J.**—TELE-TECH

17-in. Rectangular Tube

A new, 17-in., metal-shell, rectangular picture tube for television receivers has a picture area 14⅝ x 11 in. with slightly



curved sides and rounded corners. Use of the metal shell not only makes practical a construction which weighs less than a similar all-glass tube, but also facilitates the use of a high-quality face plate than is commonly used on all-glass tubes. Known as the 17 CP4, it has a design-center maximum anode-voltage of 16 kv and provides pictures having high brightness and good uniformity of focus over the whole picture area. Employing magnetic focus and magnetic deflection, the 17CP4 features an improved design of funnel-to-neck section which facilitates centering of the yoke on the neck and, in combination with better centering of the beam inside the neck, contributes to the uniformity of focus. Diagonal deflection angle is 70° and horizontal deflection angle is 66°.—**Tube Dept., Radio Corporation of America, Harrison, N. J.**—TELE-TECH

Square Wave Generator

An inexpensive step frequency type square wave generator (model SG5) has been developed for accurate high testing

of response characteristics of wide band amplifiers, wide band oscilloscopes and television video amplifiers. Five fixed output frequencies of 50, 1000, 10,000, 100,000 and 500,000 P.P.S. are provided. There is an individual calibration control for each frequency and rise time is .05 μ sec. Output voltage varies from 0.8 to 8 v. peak-to-peak. Output impedance ranges from 50 to 550 ohms depending upon attenuator setting. Each output frequency is adjustable by means of individual calibration controls. Frequencies may therefore be accurately set or their values slightly changed.—**El-Tronics, Inc., 2647 North Howard St., Philadelphia 33, Pa.**—TELE-TECH

Replacement Stylus

Said to be the most economical phonograph needle ever made, the new Duotone Diamond stylus outlasts 90 sapphire needles, the next best reproducing tip. 90 sapphires, at an average cost of $2.00 each, would cost the user $180.00 as compared to the $20.00 list price of the Duotone Diamond which provides equal playing life. Actual laboratory tests indicate that Diamond is far more gentle on record grooves because it retains its rounded polished shape long after other needles have been worn into rough destructive shapes.—**Duotone Co., Keyport, N. J.**—TELE-TECH

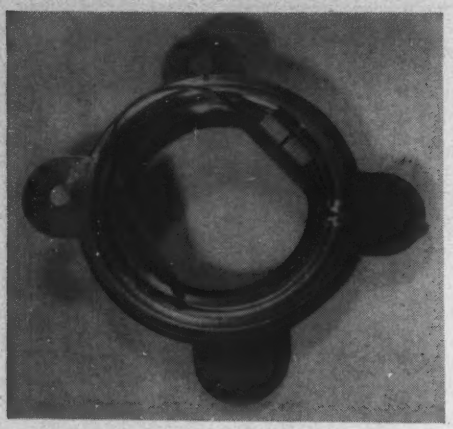
Vectorlyzer

Model 201 Vectorlyzer is based on a new fundamental circuit which permits unusual speed and accuracy for measur-

ing vector relations of alternating voltages. It has a frequency range of 8 cps to 10 MC through panel binding posts and 20 KC to 500 MC through probe. Input impedance of probe is 2.5 μμ f shunted by ¼ megohm and dielectric losses. Coaxial arrangements for matching low impedance cables are available. Input impedance of binding posts is 14 μμ f shunted by 100 megohms and dielectric losses. Accuracy is ± 3% through panel binding posts ± 1 db through probe for phase angle measurements.—**Advance Electronics Co., P. O. Box 2515, Paterson, N. J.**—TELE-TECH

Centering Unit

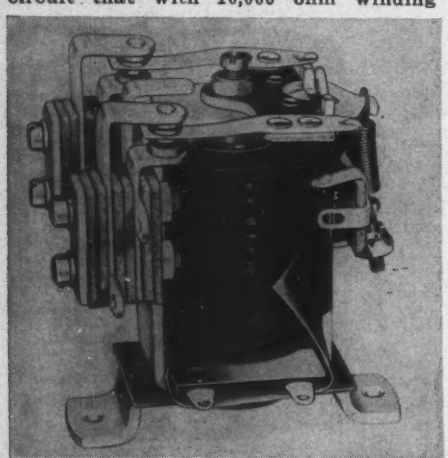
This new centering unit is composed of two ring type magnets, each having approximately a 5/16 in. air gap, enclosed in



two movable washers. Centering action is obtained by rotating these washers together or separately about the neck of the cathode ray tube. Typical range is 1¾ in. total vaster movement in any direction when using a 19AP4 tube type. While particularly suitable for centering purposes on the new electrostatically focused picture tubes, where the G-54300 would be mounted directly behind the deflection yoke, this unit can also be positioned between the yoke and focus coil on existing electro-magnetic systems.—**Guardian Electric Co., 1627 Walnut St., Chicago, Ill.**—TELE-TECH

Relays

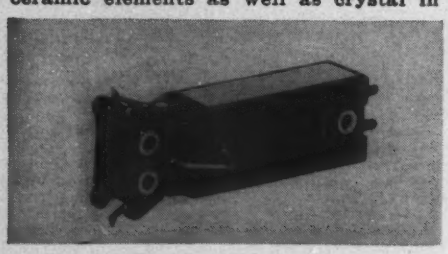
LM series relays are of the long coil construction giving a powerful magnetic circuit that with 10,000 ohm winding



permits adjustment to pull in as low as 1 ma with contact pressure sufficient to carry 5 amps. Nominal operating power is 0.1 watt. An adjustable armature return spring facilitates adjustment when installing to meet unusual or variable current or voltage conditions. The armature is equipped with an adjustable residual screw which controls the ratio between pull in and drop out current. LM relays are stocked in 2500, 5000, and 10,000 ohm windings and all contact combinations up to DPDT.—**Potter & Brumfield, Princeton, Ind.**—TELE-TECH

Phono Cartridges

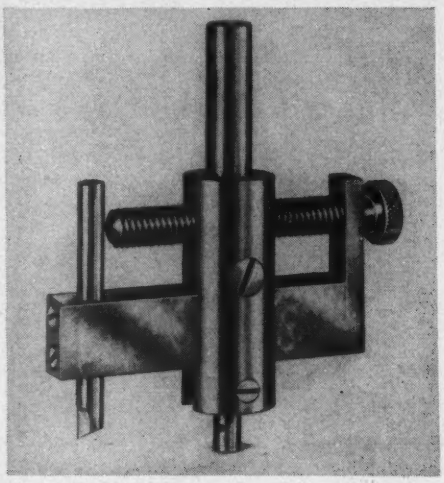
Miniature, lightweight AC series phonograph cartridges are available with ceramic elements as well as crystal in



all styles. While output of the AC ceramics is reduced, it is said to be entirely adequate for the two-stage audio amplifiers used in most radios and phonographs. External physical characteristics are the same for all models, as are the minimum needle pressures of approximately five grams. Output of the crystal models, at approximately 1 KC is 1 v., using the Audiotone 78-1 and RCA 12-5-31V test records, while that of the ceramic version is 0.4 v. Frequency range of the single-needle crystal units, with either 3-mil needle for 78 rpm or All-groove needle for all record types, is 50 cps to 10 KC, double-needle 50 cps to 6 KC. The single-needle ceramics have a frequency range of 50 cps to 6 KC; double-needle 50 cps to 5 KC.—**Astatic Corp., Conneaut, Ohio**—TELE-TECH

Circle Cutter

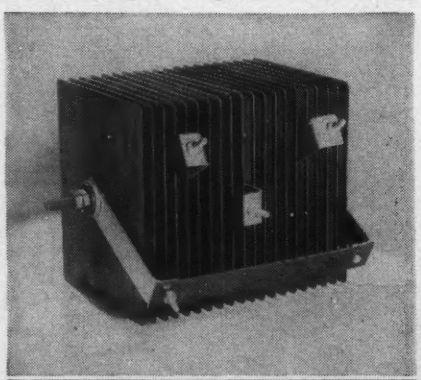
Extra heavy construction of the main beam and body make the Micro circle cutter useful for production jobs as well

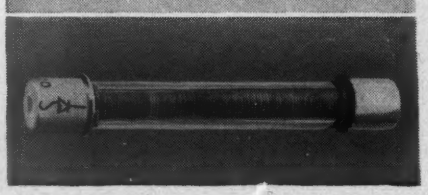


as experimental work. A micrometer type adjusting screw assures precise settings. Two types are available: round shank for drill presses or hand drills; and square tapered shank for hand braces. Maximum hole diameter is 4 in. for the model 1 and 6 in. for the model 5 cutter. All are equipped with a ¼-in. high-speed steel cutting bit.—**Precise Measurements Co., 942 Kings Highway, Brooklyn 23, N. Y.**—TELE-TECH

Rectifiers

Centre-Kooled power rectifiers are now being supplied in 10 basic cell sizes. By employing series-parallel connections





and combinations any practical current and voltage rating may be obtained. High-voltage selenium rectifiers are available in two cell sizes with inverse voltage ratings to 5000 v. and dc current ratings of 5 and 25 ma. in half wave circuits and 50 ma. in full wave circuits.—**Sarkes-Tarzian, Inc., 415 North College Ave., Bloomington, Ind.**—TELE-TECH

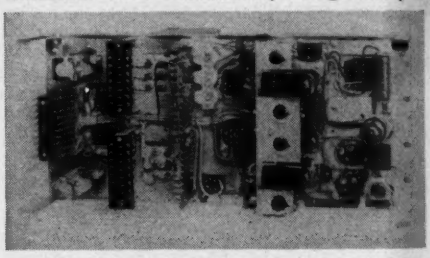
Preamplifier

A completely new and self-contained remote mixer and preamplifier has been developed for mixing four inputs (high

or low impedance mikes and crystal pick-ups) and feeding programs over remote line to main amplifying equipment (up to several miles away). Known as model 1904, it can be converted quickly for use with one to four low-impedance mikes by inserting Rauland R1002 plug-in transformers. Output is measured at 100, 400, and 5000 cps, 300 mw, 2% at 600 ohms. Frequency response is ± 1 db, 40 cps to 20 KC. Output impedance is 150/600 ohms. Hum and noise level are 47 db below rated output (unweighted) on mike and 60 db below rated power output (unweighted) on phono.—**Rauland-Borg Corp., 2515 Addison St., Chicago 18, Ill.**—TELE-TECH

Carrier Telephone System

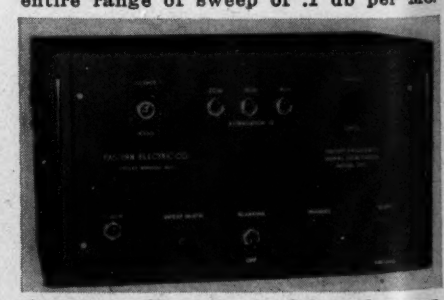
To meet the need of organizations requiring a greater number of telephone channels over moderately long lines, a



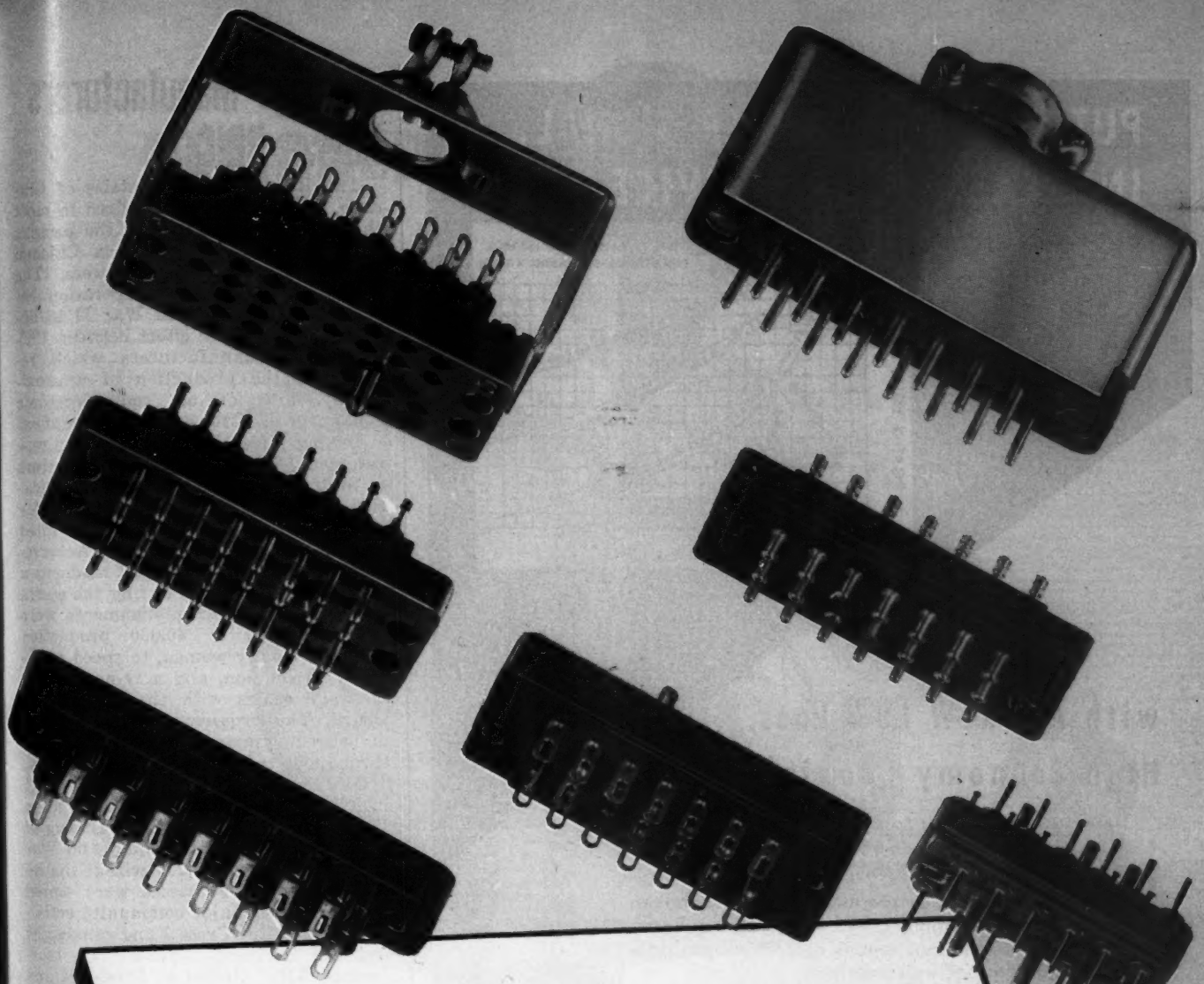
medium-haul carrier telephone system known as the FTR 9-H-2 has been developed. This system which is stackable to three channels will operate on open telephone wire over distances ranging up to 225 miles. It uses single-sideband transmission and operates at frequencies that are coordinated with those of other carrier telephone systems. The signal receiving circuit has been designed to make it less sensitive to pulse ratio variations, and new pulse ratio edjustment has been incorporated to permit optimum pulsing. In addition to use on open-wire lines, the 9-H-2 can be applied to broad-band radio links of stable characteristics.—**Federal Telephone & Radio Corp., 100 Kingsland Road, Clifton, N. J.**—TELE-TECH

Signal Generator

Model 100 sweep frequency signal generator has an amplitude variation over entire range of sweep of .1 db per MC.



Frequency linearity is 2% and sweep width is adjustable (0 to 16 MC minimum). Precision step attenuator operates in two 20-db steps and one 10-db step. Output is .5 v. across 100 ohms. Unit has an adjustable center frequency (nominally set at 25 MC). Phase adjusted horizontal voltage control is located on front panel.—**Eastern Electric Co., Box 175, Valley Stream, N. Y.**—TELE-TECH



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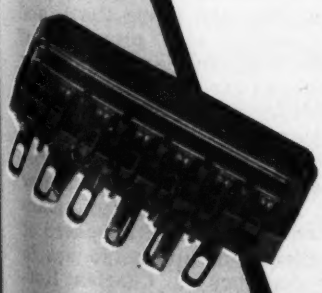
Molded general purpose connectors from three to fifty contacts available in low-loss mica, or melamine for chassis mounting or assembled with cap for cable applications, terminals gold or silver plated. Cinch experience indicated in the wide variety of designs and materials assures you the connector for your purpose. *Consult Cinch.*



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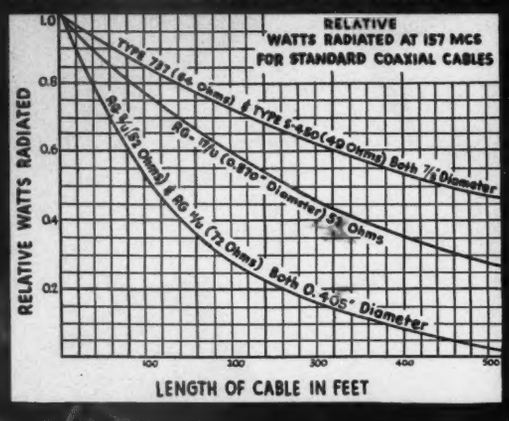

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- No maintenance or operational costs. This advantage far offsets slightly greater original cost. Seamless cable and fittings remain completely gas tight and weatherproof indefinitely.
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Whether you need transmission line for your Communications, AM or FM transmitter, Directional Antenna System, or Rhombic Receiving Array, the solution to your problem is ANDREW low loss, high economy, semi-flexible transmission line. Write for further information on Types 737 and S-450 TODAY.

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Chicago Manufacturers Revive RRIC

The Radar-Radio Industries of Chicago, Inc., has been revitalized to meet the increasing demands of the present national defense program on Chicago radio equipment manufacturers. The RRIC is a non-profit corporation established during World War II to develop a cooperative effort between Chicago radio manufacturers which resulted in the production of approximately 40% of all radio-electronic equipment used throughout the conflict.

During World War II, the group represented Chicago radio manufacturers in problems arising from war mobilization of the electronic industry and for its success was awarded the United States Navy Certificate of Achievement, the only such award made to a manufacturers' group during the entire war. Significant accomplishments were the recruiting of 30,000 production workers, mostly women, to speed emergency production, and a re-negotiation of wage scales with the War Labor Board. The organization also worked to insure maximum production efficiency throughout the Chicago radio industry.

Other contributions to the war effort included heading a successful Chicago War Loan campaign and the raising of $250,000 during a community and War Fund drive for $175,000 within the industry. Similar successes were scored in many other major community activities such as Red Cross Fund campaigns and the Shriners' Circus. The reorganized RRIC elected as President and Director, Leslie F. Muter, President of the Muter Co.

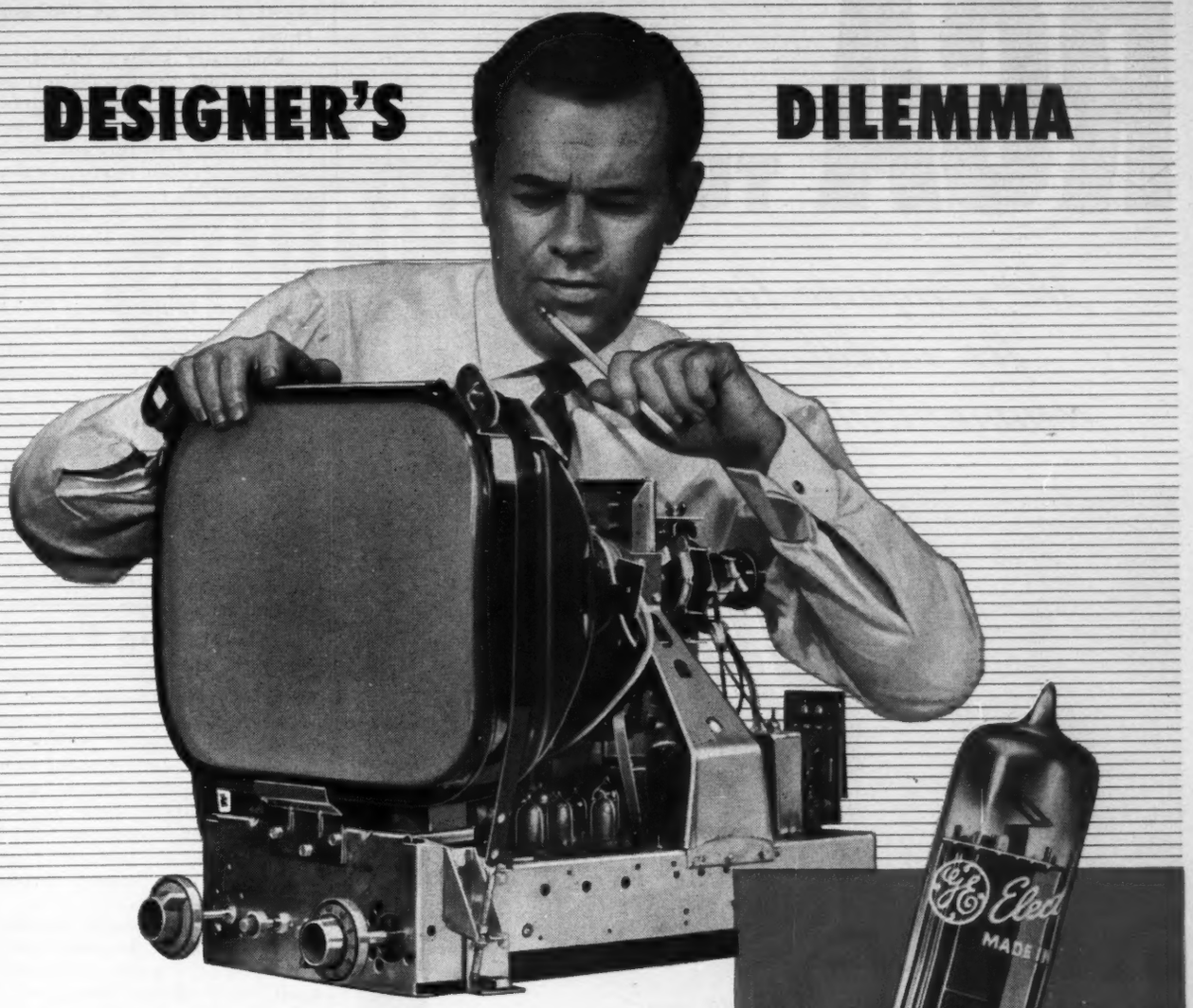
Vice president and directors are, Raymond C. Durst, executive vice president of the Hallicrafters Company, Richard C. Dooley, vice president of Admiral Corp., Paul V. Galvin, president of Motorola Inc., and James P. Wray of Croname Inc. Two additional directors are Charles M. Hofman, vice president of Belmont Radio Corp. and Henry C. Bonfig, vice president of Zenith Radio Corp. Leonard J. Shapiro, attorney, acts as executive secretary.

Three honorary directors are Hon. R. W. Twyman, former Commander in the United States Navy and Congressman during the years 1946-1948, Henry C. Forster, retired Chicago radio manufacturer, and Edward W. Shepherd of Philco. A special committee to act in emergency decisions is Charles Hofman, chairman, Raymond Durst, Richard Dooley, George R. MacDonald (treasurer of Motorola, Inc.), Robert Alexander and Henry Bonfig.

AFCA Meeting at Chicago April 19, 20

Technical forums in radio and photography will highlight the April national convention in Chicago, of the Armed Forces Communications Association, announces Theodore S. Gary, president. Convention dates will be

DESIGNER'S DILEMMA



"How can I save, in order to trim the price of this set another $2.50?"

THE answer, Mr. TV-set Designer, is simple: *G.E.'s 6BN6 gated-beam tube.* It replaces three tubes and associated components, serving as a combined limiter, discriminator, and audio-amplifier.

6BN6 cost is right in line with other receiving types. You get three tubes' performance, yet you pay for only one!

Ask for Bulletin ET-B28, which tells the full story of this amazing G-E *economy* tube, also charts its performance. Or if you prefer to discuss the 6BN6 in person, an experienced G-E tube engineer gladly will call on you. Wire or write *Section 10, Electronics Department, General Electric Company, Schenectady 5, New York.*

6BN6

GATED-BEAM MINIATURE

Typical Operating Conditions, TV Application, 4.5 mc

Plate supply voltage	270 v
Plate load resistance	.33 megohms
Accelerator voltage	100 v
Cathode resistance	200 to 400 ohms
Min signal voltage for limiting action	1.25 v RMS
Audio output voltage	12.5 v RMS
AM rejection, with 2-v input signal	25 db

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RCA TUBES ...

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RCA-5763 miniature beam power tube . . . the outstanding frequency multiplier in mobile transmitters

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PIONEERED BY RCA... and specifically designed for mobile communication . . . the RCA-5763 miniature beam power tube, and its companion—the RCA-2E26—are the accepted standards for mobile service. Performance proved in thousands of installations, these and other RCA transmitting and receiving types are your best insurance against service failures.

For data on any specific tube type, see your local *RCA Tube Distributor,* or write RCA, Commercial Engineering, Section 57CQ, Harrison, New Jersey.

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April 19 and 20, at Chicago's Drake Hotel.

Nationally known industrial leaders will conduct the discussions pertaining to military and civilian defense, and production. They will formulate plans for a closer coordination between military and civilian requirements. Current problems of communications will be stressed by Leslie F. Muter, past President of the Radio Manufacturers' Association, in the keynote address of the convention April 19.

William J. Halligan,, Sr., president of the Hallicrafters Company, and an A.F.C.A. national director, will conduct the panel on radio communications. William C. DeVry, President of DeVry Corporation, heads the discussion on photography.

Climax of the convention will be the annual banquet Friday evening, April 20, attended by civilian and military leaders, to hear an address by Robert C. Sprague, president of the Radio and Television Manufacturers Association.

Coming Events

March 5-9—American Society for Testing Materials, Spring Meeting and Committee Week, Cincinnati, Ohio.

March 19-22—IRE Annual Convention, Hotel Waldorf-Astoria and Grand Central Palace, New York City.

April 14—IRE Cincinnati Section, Fifth Annual Spring Technical Conference, Engineering Society Headquarters, Cincinnati, Ohio.

April 15-19—National Association of Radio and TV Broadcasters, Convention, Hotel Stevens, Chicago.

April 16-18—Joint Meeting of IRE and URSI, IRE Professional Group on Antennas and Wave Propagation, Spring Meeting, National Bureau of Standards, Connecticut and Van Ness Streets, N.W., Washington, D. C.

April 19-20—Armed Forces Communications Association, Fifth Annual Meeting, Drake Hotel, Chicago.

April 20-21—Southwestern IRE Conference, Dallas-Fort Worth Section and Student Branch, Southern Methodist Univ., Dallas, Texas.

April 30-May 4 — Society of Motion Picture and Television Engineers, 69th Semi-Annual Convention, Hotel Statler, New York City.

May 21-23—Electronic Parts Distributors Conference and Show, Stevens Hotel, Chicago.

May 23-25—National Conference on Airborne Electronics, Dayton Section of IRE, Dayton Biltmore Hotel, Dayton, Ohio.

June 18-20 — American Society for Testing Materials, Annual Meeting, Atlantic City, N. J.

June 25-29 — AIEE Summer General Meeting, Royal York Hotel, Toronto, Canada.

August 29-31 — 7th Annual Pacific Electronic Exhibit, IRE and West Coast Electronic Manufacturers' Assn., Civic Auditorium, San Francisco, Calif.

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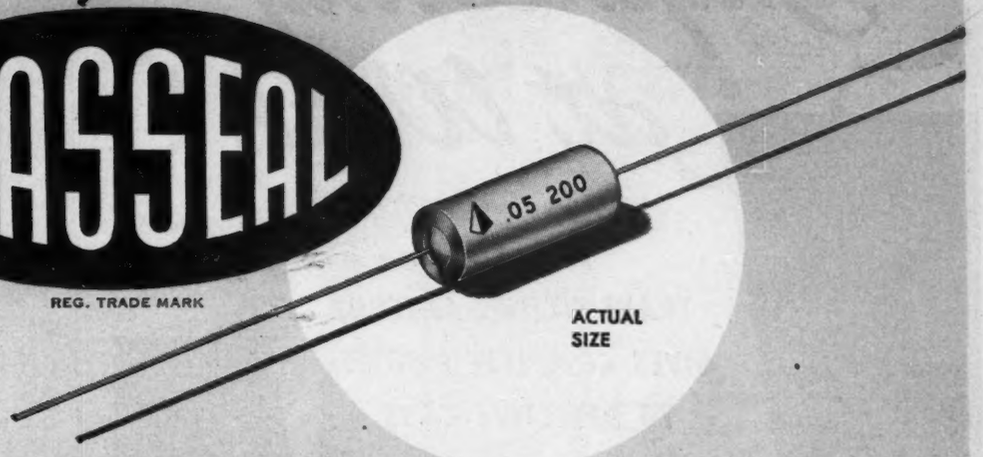
GLASSEAL

REG. TRADE MARK



ACTUAL SIZE

HERMETICALLY-SEALED *Miniature* TUBULAR PAPER CAPACITORS by PYRAMID

Pyramid Type PG "GLASSEAL" miniature paper capacitors are assembled in metal tubes with glass-metal terminals. They will fully meet the most exacting demands of high vacuum, high pressure, temperature cycling, immersion cycling and corrosion tests.

TEMPERATURE RANGES: −55° to +125°C.

CAPACITANCE RANGE: .001 mfd. to 1.0 mfd.

VOLTAGE RANGE: 100 to 600 v.d.c. operating

Your inquiries are invited

PYRAMID Electric Company

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PLANT NO. 2
155 OXFORD ST. • PATERSON, N. J.

VISIT OUR BOOTH NO. 208 AT THE IRE CONVENTION

Engineering at Work

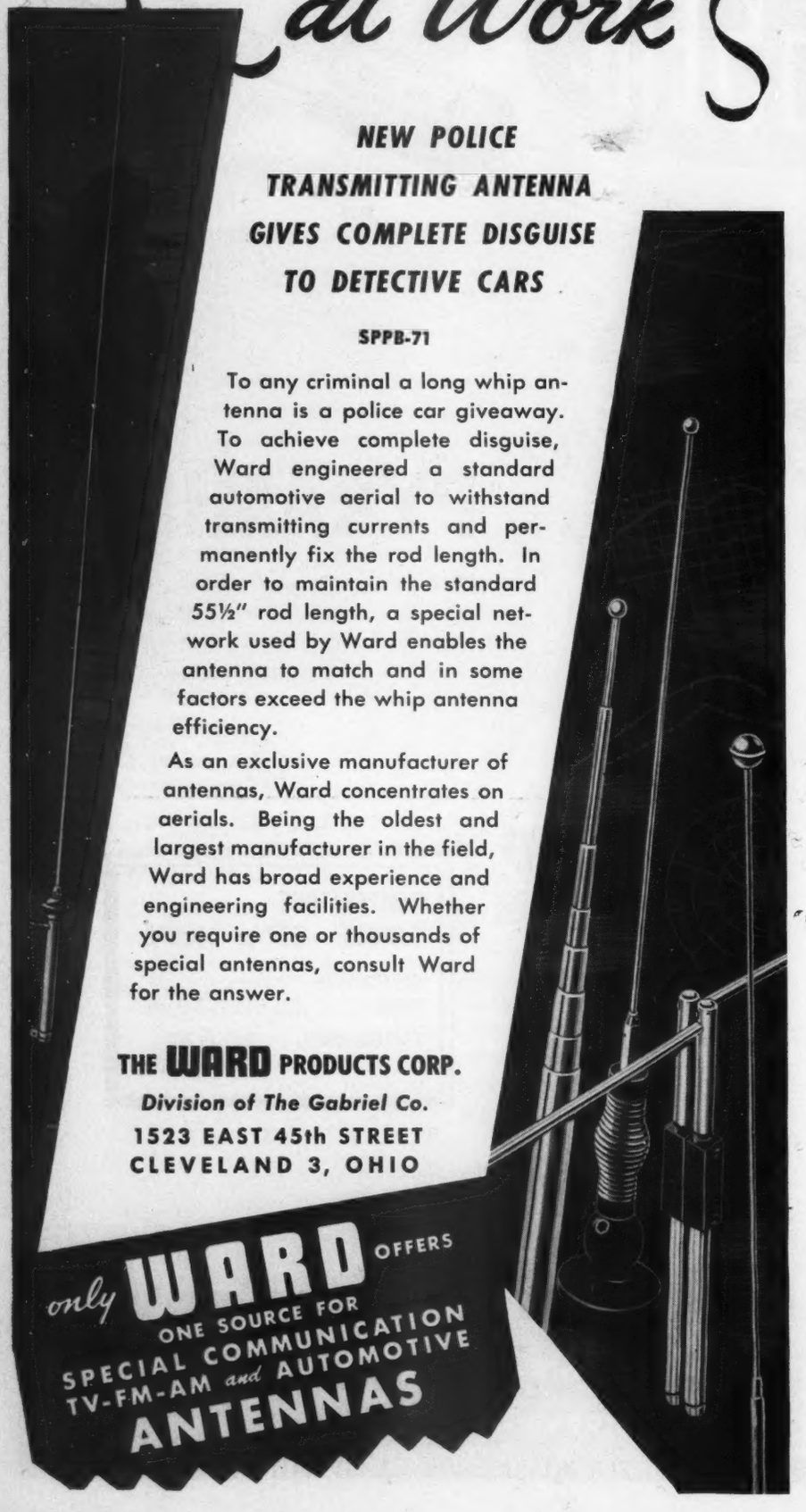
NEW POLICE TRANSMITTING ANTENNA GIVES COMPLETE DISGUISE TO DETECTIVE CARS

SPPB-71

To any criminal a long whip antenna is a police car giveaway. To achieve complete disguise, Ward engineered a standard automotive aerial to withstand transmitting currents and permanently fix the rod length. In order to maintain the standard 55½" rod length, a special network used by Ward enables the antenna to match and in some factors exceed the whip antenna efficiency.

As an exclusive manufacturer of antennas, Ward concentrates on aerials. Being the oldest and largest manufacturer in the field, Ward has broad experience and engineering facilities. Whether you require one or thousands of special antennas, consult Ward for the answer.

THE WARD PRODUCTS CORP.
Division of The Gabriel Co.
1523 EAST 45th STREET
CLEVELAND 3, OHIO



only WARD OFFERS ONE SOURCE FOR SPECIAL COMMUNICATION TV-FM-AM and AUTOMOTIVE ANTENNAS

Faster Radar Switching Tubes

Studies on the recovery time of gases, of potential value in gas-filled TR and ATR switching tubes used in close-in radar and microwave systems operating at frequencies of 3000 MC, may result in greater utilization of these microwave regions.

A quick recovery of switching tubes in short range radar is of primary importance since the amount of time lapse between transmission of a signal pulse and its return to the receiver is frequently a very few millionths of a second. Delay in the action of switching is determined by the rate of decline of electron density in the ionized gas used in switching tubes.

In a recent report by Dr. Lawrence J. Varnerin, Jr., Electronics Division, Sylvania Electric Products Inc., working in conjunction with the Evans Signal Laboratory at Belmar, N. J., the decay or decline of electron densities in ionized gases without the use of resonant structures hitherto employed is studied. A shorted length of waveguide with a quarter wavelength section of quartz next to the short was utilized. The gas under investigation was held in a quarterwave section of the guide between the quartz block and a glass vacuum window.

A high power magnetron pulse is fed into this section to set up a standing wave with maximum at the gas quartz boundary since the thickness of the quartz is one quarter wavelength and ionization begins at this point. As the heavily ionized medium builds up, the RF is attenuated and the effective region where ionization occurs moves toward the glass window.

After the ionization phase, a weak probing signal from a reflex klystron oscillator is fed into the line and a standing wave pattern is established. Because the heavily ionized medium or plasma is decaying, the standing wave ratio and phase must be determined as a function of time after the r-f phase. At any particular time a value for the impedance of the section containing the plasma can then be determined.

The propagation problem in a plasma is similar to that of propagation in the ionosphere so that results of this study may also reveal new data on the reflectance of microwaves by the ionosphere.

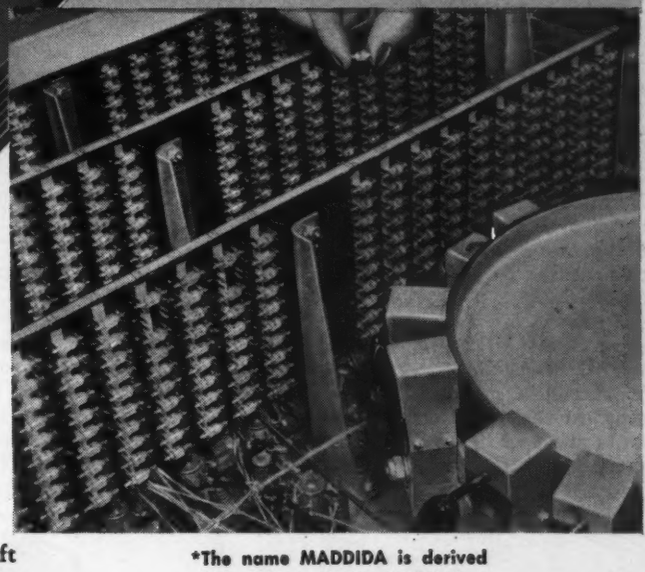
Frequencies Available for Civil Defense

The Civil Defense Administration has brought to the attention of the FCC the fact that licensed radio amateurs may be requested by the appropriate local Civil Defense authorities to provide civil defense communications or to supplement other existing communications systems for civil defense purposes.

The matter of permanent availability of specific frequency bands within the regularly allocated amateur bands for

This "brain" can stump a thousand experts

Hundreds of Sylvania Germanium Diodes simulate the synapses of the human brain, giving the machine the ability to compute, make comparisons and form decisions based on those comparisons.



SYLVANIA Germanium Diodes speed "thinking processes" of the new compact MADDIDA* Computer

This latest electronic computer, made by Northrop Aircraft Inc., is smaller than an average desk, yet it can surpass the efforts of a thousand expert mathematicians.

In a few seconds, the machine can solve complex problems requiring months or even years on standard desk calculating equipment.

Contributing to the amazing speed and to the compactness of this machine are several hundred Sylvania Germanium Diodes. Set snugly in short rows, these diodes actually function as ultra-high speed relays, shunting strings of numbers or instructions about among the vacuum tubes.

The small size of Sylvania diodes also permits compact packaging and worthwhile economies in design cost while assuring maximum efficiency of operation.

Let us acquaint you with some of the other important uses for Sylvania Germanium Diodes. Perhaps they can help you solve cost or design problems. For detailed data concerning the complete line of Sylvania Germanium Diodes, mail the coupon TODAY!

*The name MADDIDA is derived from "Magnetic Drum Digital Differential Analyzer."

Sylvania Electric Products Inc.
Dept. E-1303, Emporium, Pa.

Please send me your new 8 page catalog listing characteristics of all Sylvania Germanium Diodes.

Name_____

Street_____

City_____ Zone___ State_____

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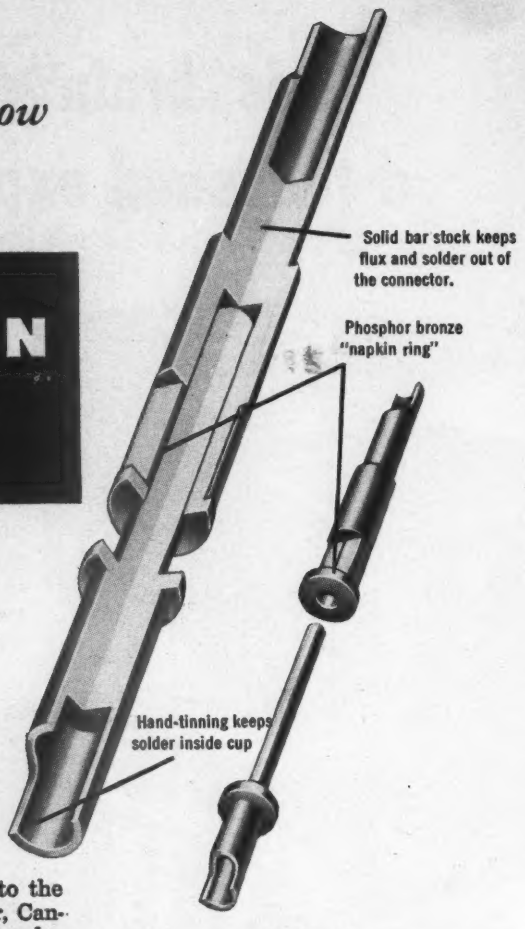
SYLVANIA ELECTRIC

FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; PHOTOLAMPS; TELEVISION SETS

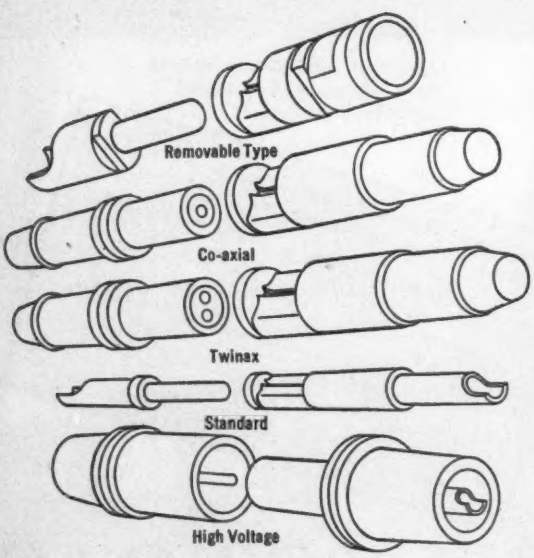
Here's why those in the know demand–

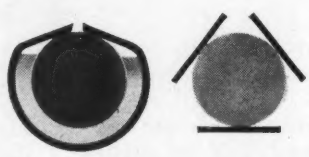
CANNON PLUGS

superior contact design


Solid bar stock keeps flux and solder out of the connector.
Phosphor bronze "napkin ring"
Hand-tinning keeps solder inside cup

Because the contact is the key to the success of any electric connector, Cannon has always applied the highest order of skill and care to this all-important detail. Cannon pin and socket contacts are all precision machined from solid bar stock. Silver or gold plating maintains high conductivity after years of constant use. Phosphor bronze "napkin ring" of the socket keeps pressure on large areas of heavy metal, preventing current loss. There are no thin metal tangent contact points in Cannon contacts. (See below). Solder cups are carefully tinned by hand to keep the solder inside the cup. Cannon socket contacts are full floating to assure perfect alignment. You'll find these design features throughout the great variety of precision contacts used in all Cannon connectors. For real value demand Cannon.





Cannon design (above left) makes contact on large, heavy metal surfaces. Current is not carried through spring section. In Cannon Connectors there are no thin metal tangent contact points, like the design shown at right.

CANNON ELECTRIC

Since 1915

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eventual use by amateurs in providing civil defense communications, after any suspension of normal amateur activity which may later be found to be necessary because of war or other national emergency, has been the subject of particular study by the Commission, the Civil Defense Administration and the Armed Forces of the United States.

The frequency bands which will remain available for civil defense use by amateurs are:

1800 – 2000 KC	50.35 – 50.75 MC
3500 – 3510 KC	53.35 – 53.75 MC
3990 – 4000 KC	145.17 – 145.71 MC
28.55 – 28.75 MC	146.79 – 147.33 MC
29.45 – 29.65 MC	220 – 225 MC

Long Life Storage Battery

A new, long-life storage battery, requiring much less maintenance and lasting half again as long as those now in use, has been developed by Bell Telephone Laboratories scientists for use in telephone central offices throughout the nation.

The battery was developed for the specific requirements of the telephone industry and while not at present recommended for other applications, its field of usefulness may be considerably extended as it becomes commercially available and more information as to its characteristics is obtained. The new battery, which is less subject to corrosion, has the further advantage of serving for many months without the addition of water, losing only 4% of its total charge each month.

Bell Laboratories researchers found that in the standard storage batteries, antimony, a metal commonly used to harden lead, was passing undetected from one plate to another within the cell, thereby speeding up corrosion and causing an electrochemical action which resulted in partial discharge of the negative plate. In this process, the by-product stibine gas, or antimony hydride, was produced.

In searching for a way to eliminate the antimony, it was learned that in experimenting with hardening agents for the lead covering of cables, metallurgists had successfully used small amounts of calcium. Less than 1/10 of 1% of calcium, compared with the 12% of antimony employed in the usual battery alloy does the job in the new lead-calcium storage battery, which now has had several years to prove its suitability and endurance under actual operating conditions.

CBS TV City in Hollywood

Construction is under way on the initial unit of CBS Television City in Hollywood, Calif. It is being erected on land known as Gilmore Island, near Beverly Hills. An elaborate functional and engineering survey of several months preceded start of construction. The first unit is being built on the site of the present Gilmore Stadium, which is being razed. The initial plant will cover more than four acres, and will consist of six studios and a six-story combination crafts and office building.

IT'S "LOADED" WITH BETTER TELEPHONE SERVICE

Twenty of the Bell System's newest small loading coils—like the one at the left—are housed in the long black case, mounted in a cable splice. This type of installation permits the economical extension of city cables to serve out-of-town subscribers.

MANY more wires can be crowded into a cable sheath when the wires are fine. But normally, wires don't transmit as well when they are fine and closely packed.

Bell engineers long ago learned to make wires do better work by loading them with inductance coils at regular intervals. The coils improve transmission and let messages travel farther. But originally the coils themselves were large, heavy and expensive. The cases to hold them were cumbersome and costly too.

So year after year Bell scientists squeezed the size out of coils. To make magnetic cores of high permeability they developed Permalloy. Tough but extra-thin insulation permitted more turns to a core.

New winding machines were developed by the Western Electric Company. Coil size shrunk to one-fiftieth. Some—like the one shown above—can be mounted right in cables themselves.

The 15,000,000 coils in the Bell System today mean thinner wires, more wires in a cable—more economical service for you. They demonstrate once more how Bell Telephone Laboratories work continually to add to your telephone's value.

BELL TELEPHONE LABORATORIES

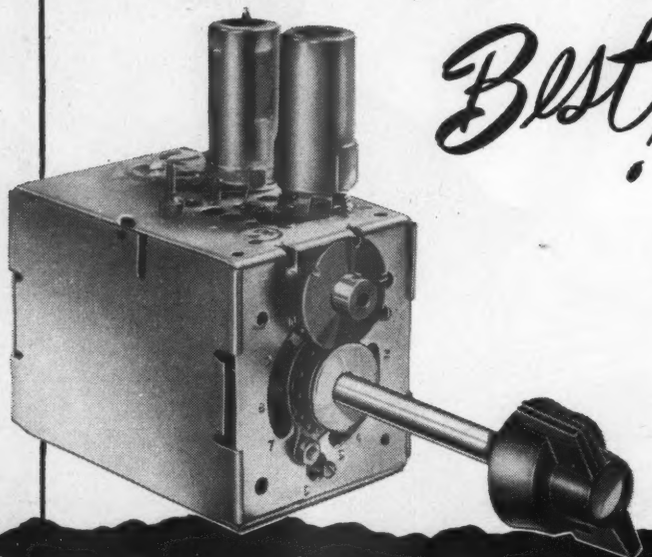
WORKING CONTINUALLY TO KEEP YOUR TELEPHONE SERVICE BIG IN VALUE AND LOW IN COST

In the laboratory...

In the field...

Repeated tests by leading set manufacturers prove it to be

Best!



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Tops in overall performance
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Manufacturers are invited to:

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2 **Request engineering service**
3 **Write for prices and availability**
4 **Inquire about latest, advanced developments**

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TUNER DIVISION
Bloomington, Indiana

OTHER TARZIAN-MADE PRODUCTS

STATIONS WTTS (5000 WATTS) AND WTTV (CHANNEL 10)
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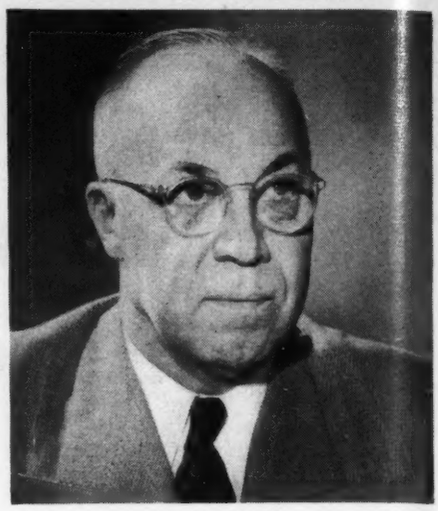
HEADS RCA MOBILIZATION



Edwin Dorsey Foster has been appointed director of a newly established Mobilization Planning Department of the RCA Victor Division, Camden, N. J. Vice Admiral Foster, USN (Ret.), was formerly Chief of Naval Material in the office of the Secretary of Navy.

TV Organization Formed Within NAB

A new autonomous television organization to operate within the structure of the 28-year-old NAB has been formed. It will be known as NAB-TV. The new board includes: Harold Hough, WBAP-TV, Fort Worth, Tex., who was chairman of the five-man NAB Committee which planned the convention; Clair R. McCollough, WGAL-TV, Lancaster, Pa.; Robert D. Swezey, WDSU-TV, New Orleans, La.; Paul Raibourn, KTLA, Los Angeles, Calif.; George B. Storer, President of the Fort Industry Co., operators of television stations in Detroit, Toledo, Atlanta and Miami; Harry Bannister, WWJ-TV, Detroit, Mich.; Campbell Arnoux, WTAR-TV, Norfolk, Va.; W. D. Rogers, Jr., KEYL, San Antonio, Tex.; Eugene Thomas, WOR-TV, New York, N. Y.

Radiofile Annual Published

The 1950 Annual issue of *Radiofile* which has just come off the press contains an index and cross-index by subject of every article of technical interest or value published during 1950 in 15 leading American radio magazines and journals—about 2,000 index items in all. The purpose of the Annual, like that of the regular bi-monthly issues, is to provide engineers with a method of locating all material published during 1950 on any radio or TV subject.

It is available for 50 cents from Richard H. Dorf, 255 West 84th St., New York 24, N. Y. Regular subscriptions for 1 year ($2.00) or 2 years ($3.50) are also offered; these provide 6 bi-monthly indexes yearly, including the Annual. Each index lists all material for the year up to date. Annuals for 1946, 1947, 1948 and 1949 are still available.

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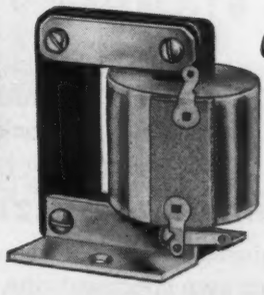
Invitation
TO RECEIVE A
PRODUCTION SAMPLE
Transformer
BUILT TO YOUR SPECIFICATIONS

this is our offer to you . . .

WE WILL, without cost or any obligation whatever, design a PRODUCTION SAMPLE transformer (hermetically sealed to JAN-T-27 or MIL-T-27 Government specifications), or open type construction, if unit is to be used for awarded prime or sub-contract work. Our approach stresses quality of product, efficiency in service and an alertness to techniques that discard the old for more functional methods.

James M. Blacklidge
PRESIDENT



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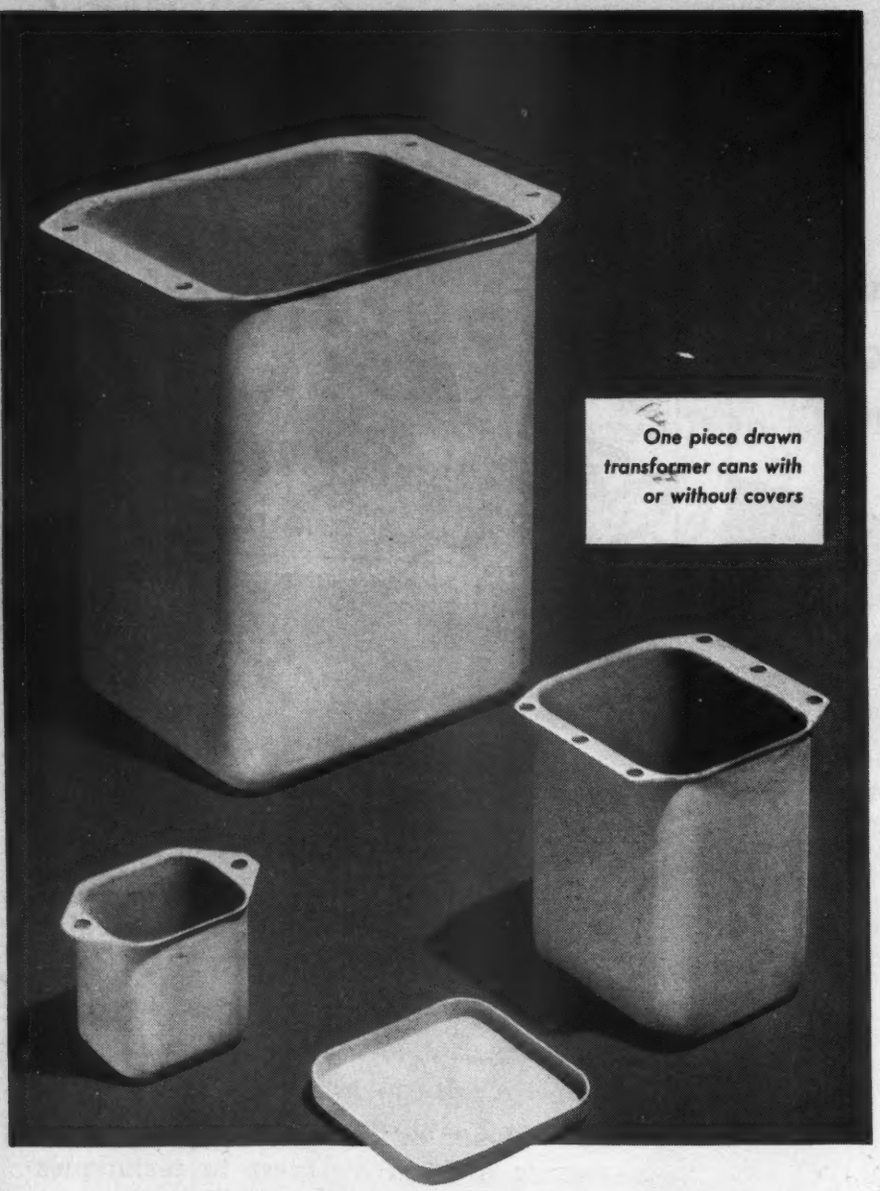

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We can save you die costs on all stock size transformer cans, and will make IMMEDIATE DELIVERY. A full range of sizes are available with or without covers. List of stock sizes and prints furnished on request.

SPECIAL SHAPES AND SIZES

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Craft Transformer Cans are drawn in one piece.

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Stainless Steel Specialists

IRE Technical Papers

(*Continued from page 47*)

—D. R. Crosby, Radio Corporation of America, Camden, N. J.
"Constant-Resistance Varying-Parameter Networks"—L. A. Zadeh, Columbia Univ., New York City.

Electron Tubes I: Employing Electron Beam

"The Rotating Beam Method for Investigating Electron Lenses"—D. E. George and M. Cooperstein, Sylvania Electric Products, Inc., Flushing, N. Y.
"The Design of 90-Degree Deflection Tubes"—H. Grossbohlin, Allen B. DuMont Laboratories, Inc., Passaic, N. J.
"A Miniature Traveling-Wave Tube for the Lower UHF Band"—R. Adler, Zenith Radio Corp., Chicago, Ill.
"Beam Analyzer"—L. R. Bloom, D. F. Holshouser, H. S. Wu, and W. W. Cannon, University of Illinois, Urbana, Ill.
"Generation of Sidebands Due to Gain and Phase-Shift Modulations in a Traveling-Wave Tube Amplifier"—M. Arditi, A. G. Clavier, and P. Parzen, Federal Telephone and Radio Corp., Nutley, N. J.

Microwaves I: Waveguides A

"Development of Waveguide Switches for Commercial and Military Applications"—T. N. Anderson, Airtron, Inc., Linden, N. J.
"Low-Loss Waveguide Transmission"—S. E. Miller and A. C. Beck, Bell Telephone Laboratories, Red Bank, N. J.
"Dominant Wave Transmission Characteristics of Oversize Round Waveguides"—Bell Telephone Laboratories, Red Bank, N. J.
"Radial Probe Measurements of Mode Conversion in Large and Round Waveguide with TE Mode Excitation"—M. Aronoff, Bell Telephone Laboratories, Red Bank, N. J.
"A Broad Band Microwave Quarter Wave Plate"—A. J. Simmons, Naval Research Laboratories, Washington 25, D. C.
"Precision Measurement of the Equivalent Circuit Parameters of Dissipative Microwave Structures"—A. A. Oliner and H. Kurss, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Symposium: Color Television

A Panel of several leading engineers from companies currently engaged in color television research and development will discuss the most recent technical advances which have been achieved in their respective laboratories during the past year.

Symposium: "Empire State Story"

A detailed discussion of the electronic, electrical, architectural and mechanical constructional features of the Empire State broadcasting facilities by a group of specialists who are specifically involved in the activity.

WEDNESDAY, MARCH 21

Symposium: Industrial Instrumentation

"Four-Gun Oscilloscope for Industrial Investigations"—M. A. Ziniuk, Halley Carburetor Co., Detroit, Mich.
"Automotive Electronic Test Equipment"—R. J. L. Dutterer and T. S. Bolton, Hastings Manufacturing Co., Hastings, Mich.
"The Vobrotron—A New Transducer"—J. Ohman and P. H. Erlandson, Southwest Research Institute, San Antonio 6, Texas.
"Electronic Relays in Automatic Process Control Systems"—R. W. Greenwood, Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
"New Techniques in Impulse Testing"—W. G. Fockler, Allen B. DuMont Laboratories, Inc., Passaic, N. J.

Computors I: Digital Computors

"The Raytheon Selection Matrix for Computer and Switching Applications"—K. M. Weiss, Raytheon Corp., Waltham, Mass.
"Saturable Reactors as Substitutes for Electron Tubes in High-Speed Digital Computers"—J. G. Miles, Engineering Research Associates, St. Paul 4, Minn.
"Ferromagnetic Cores for Three-Dimensional Digital Storage Arrays"—W. N. Papian, Massachusetts Institute of Technology, Cambridge, Mass.
"A Dependable Small-Scale Digital Computer"

for telecasting... for research... for merchandising... for industry...

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television transmitting equipment

Wherever you wish eyes and ears to extend beyond their physical range . . . wherever you wish to have many eyes see a closeup . . . whether in color or in black-and-white TV — Du Mont equipment assures you of the finest in precise, dependable, economical performance.

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TELEVISION TRANSMITTER DIVISION
CLIFTON, N. J.

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PRICE
$525.00
F.O.B. CINCINNATI

with the New Clippard PC-4 CAPACITANCE COMPARATOR

Any type of condenser . . . paper, mica, oil filled, ceramic or electrolytic . . . can be graded on the PC-4 at rates up to 8000 per day by an unskilled operator. Working to an accuracy of 0.2%, the PC-4 is a companion production instrument to the famous PR-5 Automatic Resistance Comparator. Leading manufacturers have found it an indispensible tool in the fight for higher quality and lower production costs. Easy operation reduces inspection time to an absolute minimum.

Completely self-contained, the PC-4 requires no outside attachments other than the Standard Capacitor against which the unknowns are to be checked. Operates on 110 Volt—60 cycle AC. Range: 10 mmfd to 1000 mfd. Size: 18″ x 12″ x 12″. Weight: approximately 35 lbs. For complete details, write for Catalog Sheet 3-TT.

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—J. Connolly, Teleregister Corp., New York City.
"An Asynchronous Control for a Digital Computer"—D. H. Gridley, Naval Research Laboratories, Washington, D. C.

Circuit II: Filters

"Time Domain Filters"—J. Snyder, Signal Corps Engineering Laboratories, Fort Monmouth, N. J.
"Pulse Reception Filters"—D. L. Waidelich, University of Missouri, Columbia, Mo.
"Nonlinear Sampling Filters"—W. D. White, Airborne Instruments Laboratory, Mineola, N. Y.
"Optimum Nonlinear Filters"—H. E. Singleton, General Electric Co., Schenectady, N. Y.
"Statistical Filter Theory for Feedback Systems Subject to Saturation"—G. C. Newton, Jr., Massachusetts Institute of Technology, Cambridge, Mass.
"Electrical Filters"—H. C. Sterling, Electronic Workshop, Inc., New York City

Electron Tubes II: Special Tubes and Techniques

"The Plasmatron, a Continuously-Controllable Gas Tube"—E. O. Johnson and W. M. Webster, Radio Corporation of America, Princeton, N. J.
"Switching Time Limitations in Hydrogen Thyratrons"—J. W. Woodford, Jr., Carnegie Institute of Technology, Pittsburgh, Pa.
"A New Type Heater Cathode Tube for Portable Battery-Operated Equipment"—G. W. Baker, Kip Electronic Corp., New York City
"New Vacuum Tube Materials"—E. B. Fehr and A. P. Haase, Receiving Tube Engineering, Owensboro, Ky.
"Properties of Interfaces in Metal-to-Ceramic Seals"—W. H. Cristoffers and R. P. Welling, University of Illinois, Urbana, Ill.

Microwaves II: Waveguides B

"On the Excitation of Surface Waves"—G. Goubau, Signal Corps Engineering Laboratories, Fort Monmouth, N. J.
"Interaction Between Surface Wave Transmission Lines"—A. A. Meyerhoff, Signal Corps Engineering Laboratories, Fort Monmouth, N. J.
"Multi-Element Directional Couplers"—S. E. Miller and W. W. Mumford, Bell Telephone Laboratories, Red Bank, N. J.
"The Effect of Radiation on the Q of Resonant Sections"—R. A. Chipman, McGill, Univ., Montreal, Quebec, E. F. Carr and N. A. Hoy, General Electric Co., Syracuse, N. Y.

Symposium: Some Systems Problems of Air Traffic Control

"Weather"—N. A. Lieurance, U. S. Weather Bureau, Washington, D. C.
"Aircraft and Airport Characteristics"—L. P. Tabor, Franklin Institute, Philadelphia, Pa.
"Economic Demand"—F. B. Lee, Civil Aeronautics Administration, Washington, D. C.
"Human Engineering"—P. M. Fitts, Ohio State Univ., Columbus, Ohio
"Traffic Control Theory"—D. H. Ewing, Air Navigation Development Board, Washington, D. C.

Electronic Instrumentation

"Microwave Methods in Gas Analysis"—J. Weber, Naval Ordnance Laboratory, White Oak, Md.
"X-Ray Liquid Level Gage"—J. E. Jacobs and R. F. Wilson, General Electric X-Ray Corp., Milwaukee, Wis.
"Noise Figure Standards"—M. Solow, I. W. Hammer, and P. H. Haas, National Bureau of Standards, Washington, D. C.
"Spark Over of Air at Radio Frequencies"—W. Cawood, Jr., Carnegie Institute of Technology, Pittsburgh 13, Pa.
"New Limits for Low-Level RF Measurements"—W. K. Volkers, Millivac Instrument Corp., New Haven, Conn.

Computers II: Analogue Computers

"A Sampling Analogue Computer"—J. Broomall and L. Riebman, Univ. of Pennsylvania, Philadelphia, Pa.
"A Time-Division Multiplier for a General Purpose Electronic Differential Analyzer"—R. V. Baum and C. D. Morrill, Goodyear Aircraft Corp.
"A High-Speed Product Integrator"—A. B. Macnee, University of Michigan, Ann Arbor, Mich.
"Plug-In Units for Digital Computation"—G. Glinski and S. Lazecki, Computing Devices of Canada Ltd., Ottawa, Canada
"A Five-Digit Parallel Coder Tube"—J. V. Harrington, K. N. Wulfsberg, Air Force Cambridge Research Laboratory, Cam-

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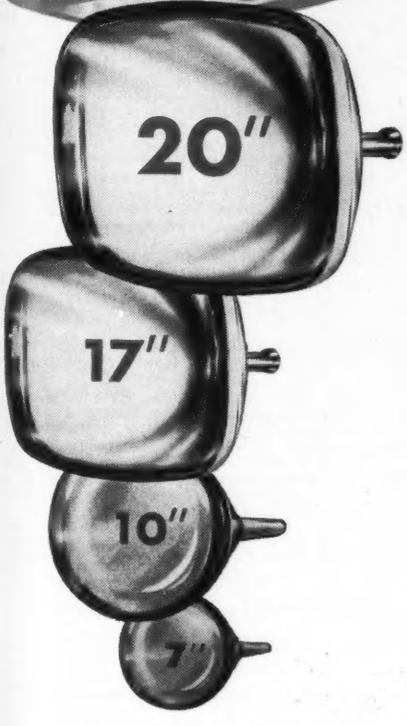


The recently announced 20" *all-glass* television bulb illustrates how tube manufacturers can always look to Corning for the latest developments. There are excellent reasons for this. The adaptability of glass in the hands of Corning technicians is one thing. For another, glass manufacturing methods are flexible. *All-glass* bulbs paced the 1950 trend to rectangular shapes and larger sizes, and continue to lead in 1951.

Size is only part of the story. Specially designed automatic machinery permits manufacturing of *all-glass* TV bulbs on a mass production basis. Corning engineering and research are constantly improving quality, strength and over-all dimensional precision in an effort to help you make the best tubes possible.

It will pay *you* to look to Corning for *all* of your bulb requirements.

PYREX

CORNING GLASS WORKS, CORNING, N. Y.

Corning means research in Glass

ELECTRONIC SALES DEPARTMENT—ELECTRICAL PRODUCTS DIVISION

1851 · 100 YEARS OF MAKING GLASS BETTER AND MORE USEFUL · 1951

Browning OSCILLOSYNCHROSCOPES

for high-speed pulse work, radar, hf, TV, communications, facsimile

THESE ARE THE HIGHLIGHTS of equipment for laboratory research and development requiring a variety of time bases, triggers, phasing and delay circuits, and extended-range amplifiers for use in the study of wave shapes, very short pulses, and irregular transients.

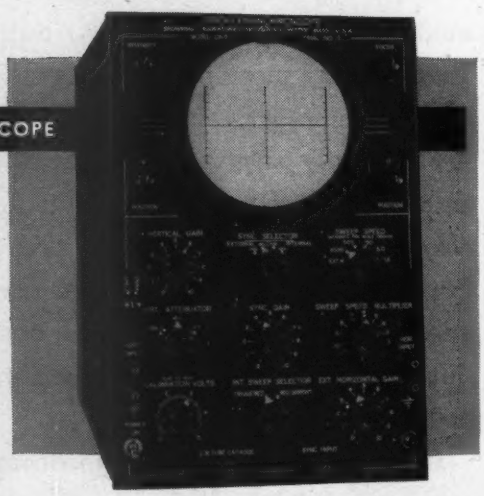
MODEL OJ-17 OSCILLOSYNCHROSCOPE

A wide-band oscillosynchroscope for high-speed pulse work and study of complex wave shapes with hf components. Entire equipment is mounted in vertical rack cabinet; convenient mounting for camera to record screen images.

Circuit Features

• 5" 5RP or 5XP CR tube; anode voltage variable 10 to 20 kv. • Vertical amplifier bandwidth flat to 16 mc with response beyond 30 mc.; deflection sensitivity 0.05 volts/inch; video delay 0.2 miscroseconds • Horizontal amplifier bandwidth 2 mc.; deflection sensitivity 0.25 volts/inch • Driven sweep variable 0.05 to 500 miscroseconds/inch; saw-tooth sweep 5 to 500,000 c.p.s. • Trigger-generator output 100 volts from 500 ohms; running rate 20 to 20,000 c.p.s. • Internal blanking or deflection markers at 0.1, 1, 10, and 100 microsecond intervals • External grid connection for beam intensity modulation • Delay continuously variable to 2000 microseconds; directly calibrated dial.

Size: 81⅜"x25⅝"x24"
Weight: 500 lbs;
shipping weight: 750 lbs.



MODEL ON-5 OSCILLOSYNCHROSCOPE

Gives you the basic equipment for viewing any voltage wave shapes — pulse or sine wave — radar or TV to audio — in a single, compact unit.

Circuit Features

• 5" CR tube 5UP1 • Triggered sweep continuously variable 1 to 25,000 microseconds/inch with direct panel calibration • Saw-tooth sweep 10 cycles to 100 KC • Vertical amplifier flat ± 3db from 5 cycles to 5 mc. @ 0.075 volts/inch • Self-contained vertical-deflection calibration means • Horizontal amplifier d.c. to 500 KC @ 2 volts/inch • Portable • Low cost.

Bulletins containing detailed information about these two versatile instruments will be sent at your request.

In Canada, address:
Measurements Engineering Ltd.
Arnprior, Ontario.

ENGINEERED FOR ENGINEERS

BROWNING
Laboratories, Inc.
Winchester, Mass.

bridge, Mass. and G. R. Spencer, Philco Corp., Philadelphia, Pa.

Circuits III: General

"A Linear Operational Calculus of Empirical Functions"—R. G. Piety, Phillips Petroleum Corp., Bartlesville, Oklahoma
"Pulse Transfer Considered as a Wide-Band Network"—E. G. Rudenberg, Raytheon Manufacturing Corp., Waltham, Mass.
"Single-Tapped Coil Delay Line"—S. G. Lutz, New York Univ., New York 53, N. Y.
"Nickel Acoustic Delay Line"—T. F. Rogers, Air Force Cambridge Research Laboratories, Cambridge, Mass. S. J. Johnson, Anderson-Shaw Labs., Hartford, Conn.
"Amplifier Synthesis on Equal-Ripple Basis"—D. L. Trautman and J. Aseltine, University of Calif., Los Angeles, Calif.

Broadcast and TV Receivers

"90-Degree Deflection Yoke Design—The Design of Wide Angle Deflection Yokes"—H. Thomas, Allen B. Du Mont Laboratories, Inc., Passaic, N. J.
"Semi-Automatic Fabrication of Audio and Video Equipment"—W. H. Hannahs, R. Bahr, and J. Caffiaux, Sylvania Electric Products, Inc., Flushing, N. Y.
"UHF Converter"—B. F. Tyson, Sylvania Electric Products, Inc., Flushing, N. Y.
"Power Supplies for Television Receivers"—A. M. Levine and S. Moskowitz, Federal Telecommunication Laboratories, Nutley, N. J.
"Radio Receiver Subminiaturization Techniques"—G. Shapiro, National Bureau of Standards, Washington, D. C.

Microwaves III: Antennas and Artificial Dielectrics A

"The Study of Artificial Dielectrics of the Obstacle Type"—C. Susskind, Yale Univ., New Haven, Conn.
"Isotropic Artificial Dielectrics"—Air Force Cambridge Research Laboratories, Cambridge, Mass.
"A Virtual Source in Microwave Optics"—K. S. Kelleher, Naval Research Laboratories, Washington, D. C.
"Experimental Prototype of the Rinehart-Luneberg Lens"—E. C. Fine, Air Force Cambridge Research Laboratories, Cambridge, Mass.
"Propagation of Microwaves Between Parallel Conducting Surfaces"—K. S. Kunz, Carnegie Institute of Technology, East Pittsburgh, Pa.
"Phase Shift of Microwaves in Passage Through Parallel-Plate Arrays"—D. J. Epstein, Massachusetts Institute of Technology, Cambridge, Mass.

Radar and Navigation

"On the Measurement of the Radar-Echoing Areas of Conducting Bodies"—J. R. Mentzer, Ohio State Univ., Columbus, Ohio
"Polarization Properties of Target Reflections"—E. M. Kennaugh, Ohio State Univ., Columbus, Ohio
"The Use of Circular Polarization as a Means of Reducing Radar Precipitation Return"—W. D. White, Airborne Instruments Laboratory, Mineola, N. Y.
"An ICW System for Distance Measurements"—J. Lyman, G. Litchford, and G. Grunsky, Sperry Gyroscope Corp., Great Neck, N. Y.
"Effects of Vertical Radiation Pattern on Omnirange Beacon Characteristics"—S. Pickles, Federal Telecommunication Laboratories, Nutley, N. J.

THURSDAY, MARCH 22

Nuclear Science

"A Delayed Coincidence Scintillation Spectrometer"—F. K. McGowan, Oak Ridge National Laboratory, Oak Ridge, Tenn.
"Timing Unit and Pulse Deflector Generator for 145-Inch Synchrocyclotron"—E. M. Williams, C. H. Grace, and L. W. Johnson, Carnegie Institute of Technology, East Pittsburgh, Pa.
"Design and Construction of a Billion-Volt Linear Electron Accelerator"—M. Chodorow, E. L. Ginzton, J. Jasberg, R. Kyhl, R. Neal and P. Pearson, Stanford Univ., Stanford, Calif.
"Precise Measurement and Regulation of Magnetic Fields with RF Techniques Using Nuclear Resonance"—H. A. Thomas, National Bureau of Standards, Washington, D. C.
"A High-Precision Magnetic Field Measuring Instrument"—E. C. Levinthal, Varian Associates, San Carlos, Calif.

Television II

"Parallel Operation of Vacuum Tubes at UHF to Obtain High Transmitter Power"—W. H. Sayer, Jr., and E. Mehrbach,

(*Continued on page 74*)

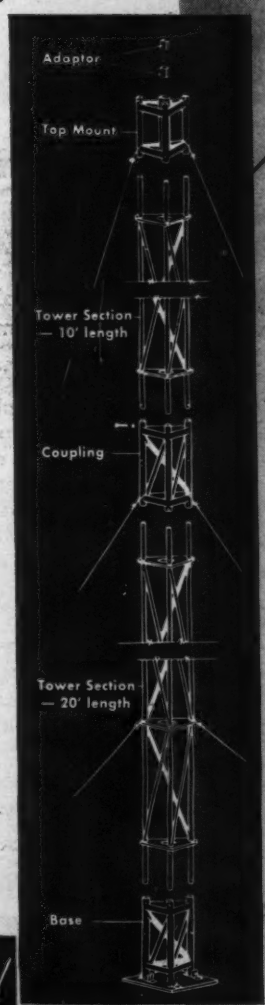
THE TOWER OF STRENGTH

IDEAL FOR
COMMUNICATIONS
MICROWAVE
TELEVISION
LIGHTING

Superior construction features give LOW COST Vee-D-X sectional towers the highest safety factor of any tower in its price class.

If you have an elevated installation problem, absolute permanency of your installation is assured when you use a VEE-D-X sectional tower. Strength is a major factor. Don't take chances with structural failure. Be sure with VEE-D-X!

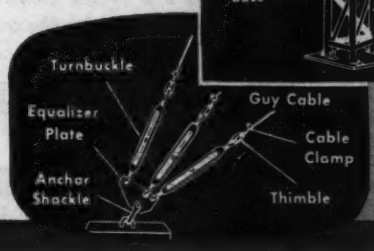
- *Rugged, all-welded construction diagonally laced with angle iron for maximum rigidity.*
- *Can be erected on ground or on flat or peaked roof.*
- *Patented plate spaced at two foot intervals prevents twisting and affords rigidity found in no other tower.*
- *Safe and easy to climb.*
- *Completely galvanized, light weight tubular steel . . . 20 ft. section 72 lbs.*



PRE-ASSEMBLED
for fast, inexpensive installation

VEE-D-X towers are designed for use at any height from 10 to 140 feet. They are self-supporting up to 20 feet and, where space is limited, *semi-guyed** type installations may be used at 30, 40, and 50 foot heights. Sketch at right shows the basic parts and necessary accessories for a complete installation. Three types of top mount are available. VEE-D-X towers may be ordered in separate units or as a complete package for a specific height. (Either guyed or semi-guyed.) Write the LaPointe-Plascomold Corporation of Unionville, Conn. for complete information.

*Semi-guyed towers employ one set of guy cables attached at a height of 10 ft. up the tower and anchored at a 6 ft. radius from the base.



VEE-D-X

BUILDERS OF THE WORLD'S MOST POWERFUL ANTENNAS

Specify BREEZE "Monobloc" Waterproof and Pressure Sealed CONNECTORS

The only APPROVED Monobloc System for Advanced Radar, Communications, and Electronic Equipment

Breeze "Monoblocs", with single piece plastic inserts, offer outstanding advantages in assembly, wiring, mounting and service in the field.

Single piece inserts make a tighter unit, eliminate the air spaces within conventional multiple-piece inserts, greatly reduce the opportunity for moisture shorts.

Removable contact pins make possible bench soldering of leads, quick, error free assembly of Breeze Waterproof Connectors and panel-type "Monobloc Miniatures."

Single-Hole Panel Mounting is all that is required for either Waterproof or Pressure Sealed types.

Pressure Sealed types are available for values up to and including 75 psi, or they can be specially engineered for greater pressures. They meet specified requirements of shock, vibration, salt spray, humidity and temperature cycling from −65° to +185° F.

Breeze "Monobloc" Waterproof and Pressure Sealed Connectors are engineered to your requirements in aluminum, brass or steel—in all sizes and capacities. They are fully tested and approved... cost no more than ordinary types.

Write for Details

If you have a tough connector problem, ask BREEZE for the answer!

Other Breeze Precision Products

ACTUATORS: All types, sizes. Complete control systems engineered to requirements. Above: Landing gear actuator Fairchild Packet.

RADIO SHIELDING: For any type of high or low tension system. New type "unit leads" or re-wirable leads. Flexible shielded conduit.

"AERO-SEAL" Worm-Drive Hose Clamps. Vibration proof, uniform clamping, use again and again. All clamps have stainless steel bands.

BREEZE

CORPORATIONS, INC.

411 South Sixth Street, Newark 7, N. J.

Photo illustrating effectiveness of Signal Corps miniaturization program on components as shown by two carbon resistors

Allen B. Du Mont Laboratories, Inc., Passaic, N. J.

"An Ultra-Portable Television Pickup Equipment"—L. E. Flory, W. S. Pike, and J. E. Dilley, Radio Corporation of America, Princeton, N. J.

"The Technique of Dot Arresting for Television Transmission Using Dot Interlace"—K. Schlesinger, Motorola, Inc., Chicago.

"A Sweep Method for Measuring the Transmission Amplitude Characteristic of a Television Transmitter"—J. Ruston, Allen B. Du Mont Laboratories.

Circuits IV: Amplifiers

"RF Amplifier Design for Low Noise Figure"—R. Guenther, Signal Corps Engineering Laboratories, Fort Monmouth, N. J.

"HF Amplifiers with Direct Coupling"—D. R. Crosby and K. F. Umpleby, Bendix Aviation Corp., Baltimore 4, Md.

"Distributed Amplification: Additional Considerations"—J. Weber, Naval Ordnance Laboratory, White Oak, Silver Spring, Md.

"Distributed Amplification for Pulses"—R. B. White, Naval Research Laboratories, Washington 20, D. C.

"Cathode-Coupled Clipper Response"—P. F. Ordung and H. L. Krauss, Yale Univ.

Symposium: Telemetering Systems

"Telemetry and the Guided Missile Program"—C. H. Hoeppner, General Electronics Laboratory, Boston, Mass.

"FM/FM Telemetry"—M. V. Kiebert, Jr., Raymond Rosen Engineering Products, Philadelphia, Pa.

"Special Applications for FM/FM Telemetry"—W. J. Mayo-Wells, Applied Physics Laboratory, Silver Springs, Md.

"The Case for PWM/FM Telemetry"—J. B. Kauke, Douglas Aircraft Corp., Santa Monica, Calif.

"PTM Telemetry"—A. H. Nelson, General Electronics Laboratory, Boston, Mass.

Audio

"A Single-Ended Push-Pull Amplifier"—A. Peterson and D. B. Sinclair, General Radio Corp., Cambridge, Mass.

"The Application of Damping to Phonograph Reproducer Arms"—W. S. Bachman, Columbia Records, New York, N. Y.

"Transient Testing of Loudspeakers"—O. K. Mawardi, Harvard Univ., Cambridge, Mass.

"A Practical Speech Silencer for Radio Receivers"—R. C. Jones, Polaroid Corp., Cambridge 39, Mass.

Microwaves IV: Antennas and Artificial Dielectrics B

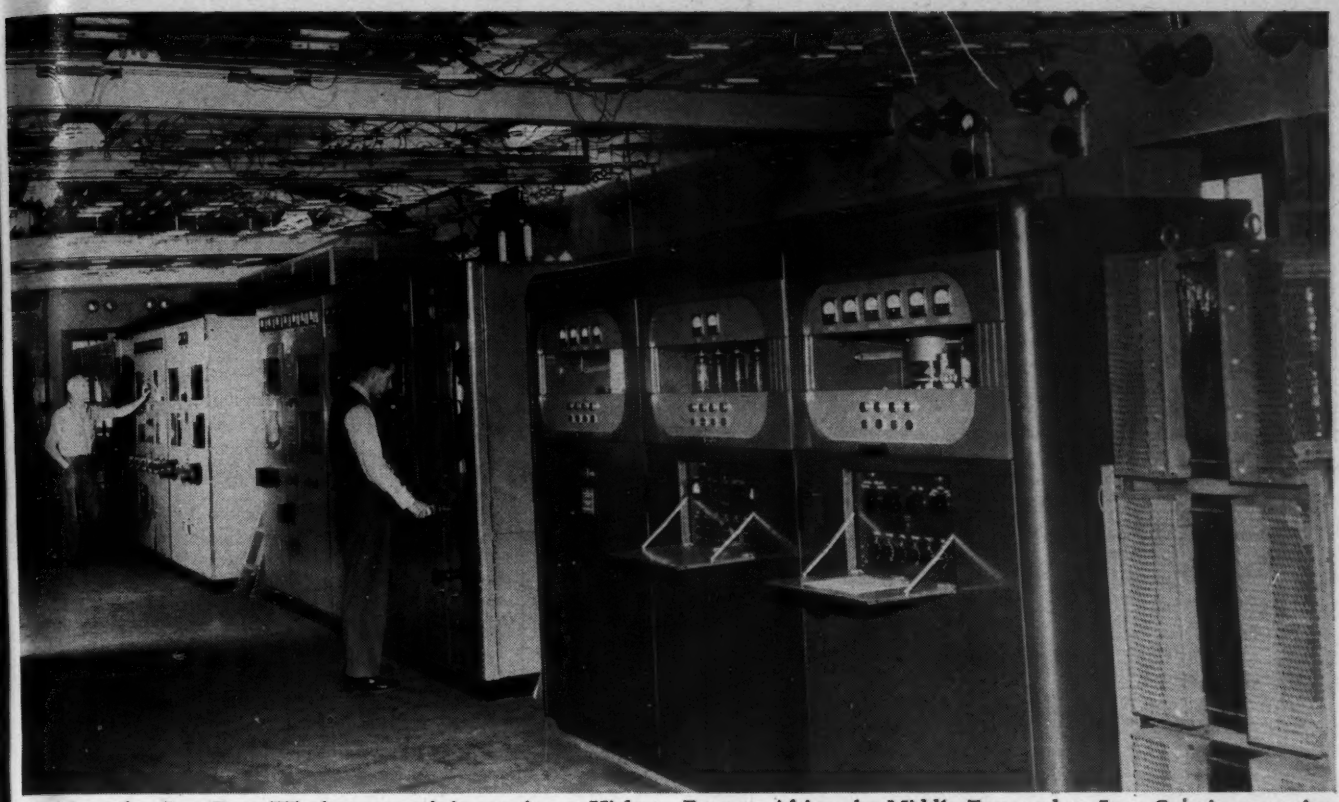
"The Half-Space as a Spherical Transmission Line"—L. Felson and N. Marcuvitz, Polytechnic Institute of Brooklyn.

"The Calculation of Progressive-Phase-Shaped-Beam Antennas"—A. S. Dunbar, Stanford Research Institute, Stanford, Calif.

"Physical Limitations on Minimum Side Lobes in Broadside Arrays"—J. Ruze, Air Force Cambridge Research Laboratories, Cambridge, Mass.

"The Behavior of Microwaves in Focal Regions"—F. J. Zucker, Air Force Cam-

(*Continued on page* 98)

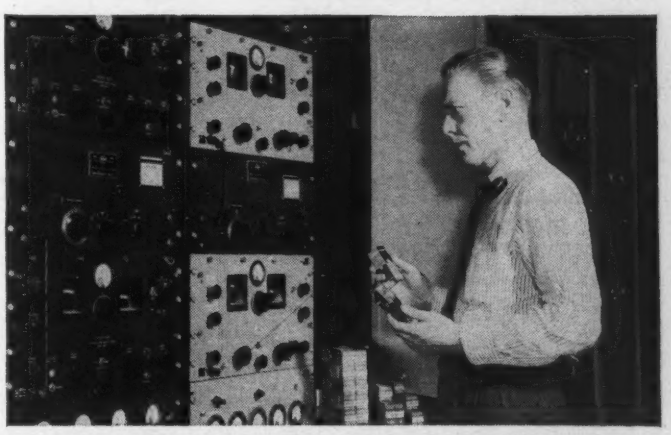


An aisle at the giant Press Wireless transmitting station at Hicksville, Long Island, N. Y., showing 3 of the 35 transmitters (from 25 to 50 kw output), in constant use. These transmitters beam news to North America, Central America, and South America, Europe, Africa, the Middle East, and to Iron Curtain countries, including the U.S.S.R., through the Voice of America and United Nations broadcasts. All the transmitters are keyed and controlled with equipment using Sylvania Radio Tubes.

SYLVANIA RADIO TUBES HELP PRESS WIRELESS CARRY THE NEWS TO ALL THE WORLD!

Voice of America broadcasts to Russia and the Iron Curtain countries . . . United Nations broadcasts to the world . . . news stories and pictures for the world's newspapers, magazines, and radio stations . . . this is the vital 24-hour-a-day task of the far-flung transmitters and receivers of Press Wireless, Inc. Jointly owned by leading newspapers and news services, Press Wireless is handling the biggest job of news transmission the world has ever known!

With such an urgent mission, dependability is the keynote. And naturally, to insure that dependability, Press Wireless uses Sylvania Radio Tubes by the thousands in its equipment. Like expert production and design engineers everywhere, Press Wireless' staff has found by experience that Sylvania precision, uniformity, and reliability add up to quality that can't be beat. For complete characteristics of radio tubes for every application, or for help on your special problems, write Sylvania Electric Products Inc., Dept. R-1403, Emporium, Pa.



At the Press Wireless Receiving Station at Baldwin, Long Island, N. Y., all 29 receivers use Sylvania Radio Tubes in many applications. Tuned to London, Paris, Rome, Moscow, Madrid, Buenos Aires, Mexico City, and many other news centers, they receive code and voice transmissions as well as teletype, and radio photos for dissemination to all America.

SYLVANIA ELECTRIC

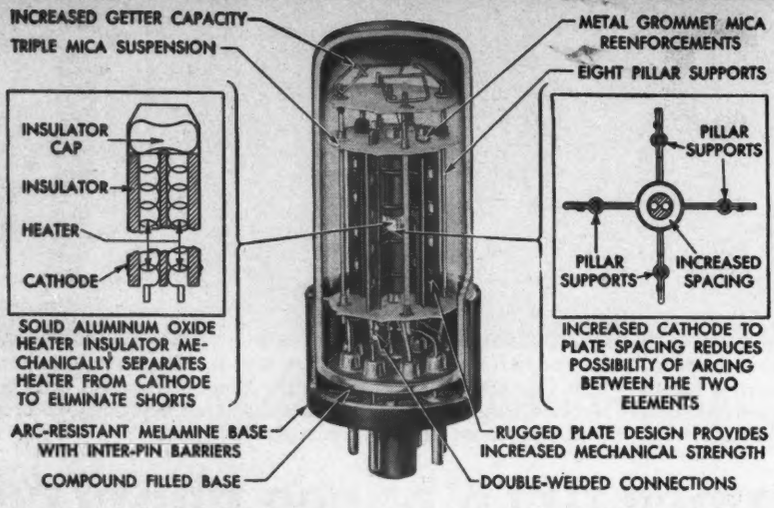
RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

RECTIFIER TUBES

RUGGEDIZED BY

ECLIPSE-PIONEER

FOR ADDED RELIABILITY


INCREASED GETTER CAPACITY
TRIPLE MICA SUSPENSION
INSULATOR CAP
INSULATOR
HEATER
CATHODE
SOLID ALUMINUM OXIDE HEATER INSULATOR MECHANICALLY SEPARATES HEATER FROM CATHODE TO ELIMINATE SHORTS
ARC-RESISTANT MELAMINE BASE WITH INTER-PIN BARRIERS
COMPOUND FILLED BASE
METAL GROMMET MICA REENFORCEMENTS
EIGHT PILLAR SUPPORTS
PILLAR SUPPORTS
PILLAR SUPPORTS
INCREASED SPACING
INCREASED CATHODE TO PLATE SPACING REDUCES POSSIBILITY OF ARCING BETWEEN THE TWO ELEMENTS
RUGGED PLATE DESIGN PROVIDES INCREASED MECHANICAL STRENGTH
DOUBLE-WELDED CONNECTIONS

We are not in the standard vacuum tube business, but we are in the business of developing and manufacturing a reliable line of special purpose electron tubes—tubes that will serve and meet the stiff and varied operational requirements of aviation, ordnance, marine and other fields of modern industry. Typical of these are receiving type tubes such as Beam-Power Amplifiers, R-F Pentodes, Twin Triodes, and the Full-Wave Rectifiers illustrated above and described below. All of these tubes are exhausted on a special automatic exhausting machine capable of extra high evacuation, and are aged under full operating and vibration conditions for a period of 50 hours. In addition to the tubes described above, Eclipse-Pioneer also manufactures special purpose tubes in the following categories: gas-filled control tubes, Klystron tubes, spark gaps, temperature tubes and voltage regulator tubes.

LOOK FOR THE PIONEER MARK OF QUALITY
REG. U. S. PAT. OFF.

Electrical Characteristics of E-P Full-Wave Rectifier Tubes

TUBE TYPE	R.M.A. 5838	R.M.A. 5839	R.M.A. 5852	R.M.A. 5993
Heater Voltage	12 volts	26.5 volts	6.3 volts	6.3 volts
Heater Current	0.6 amps.	0.285 amps.	1.2 amps.	0.80 amps.
Peak Inverse Voltage	1375 v. (max.)	1375 v. (max.)	1375 v. (max.)	1250 v. (max.)
Peak Plate Current (per plate)	270 ma. (max.)	270 ma. (max.)	270 ma. (max.)	230 ma. (max.)
D-C Heater-Cathode Potential	450 v. (max.)	450 v. (max.)	450 v. (max.)	400 v. (max.)
Cathode Heating Time	1 min.	1 min.	1 min:	45 sec.
Total Effective Plate Supply Impedance	150 ohms (min.)	150 ohms (min.)	150 ohms (min.)	150 ohms (min.)

Other E-P precision components for servo mechanism and computing equipment:

Synchros • Servo motors and systems • rate generators • gyros • stabilization equipment • turbine power supplies and remote indicating-transmitting systems.

For detailed information, write to Dept. B

ECLIPSE-PIONEER DIVISION of Bendix AVIATION CORPORATION

TETERBORO, NEW JERSEY

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

PERSONNEL

Allan Easton has been named chief of the microwave section of Radio Receptor Co., Inc., Brooklyn, N. Y. He was formerly chief engineer of the production engineering division of Teletone Radio Corp.

Edward S. White has been appointed assistant chief of advanced development of Air King Products Co., Inc., Brooklyn, N. Y. Prior to joining Air King he was senior engineer with the RCA Industry Service Laboratory.

T. Robinson Cox has been elected a director and first vice president of Beam Instruments Corp., New York City. During World War II he was director of the Radio Electrical division of the British Air Commission in Washington. Following the war he became general manager of the RCA international division in New York.

Sidney Warner has been appointed director of engineering and research of the LaPointe-Plascomold Corp., Windsor Locks, Conn., manufacturers of Vee-D-X television antennas and accessories.

Dr. A. V. Astin, formerly chief of the Electronics and Ordnance Division of the National Bureau of Standards, has been appointed associate director of the NBS. In this capacity he is responsible for the activities of the Divisions of Electronics, Ordnance Development, Missile Development, and the Office of Basic Instrumentation, and for coordination of NBS operations with other government agencies.

Col. John R. Howland, identified with the television industry since 1935 and a colonel in the Signal Corps during World War II, has been named to head the newly-created Office of Product Research for Stewart-Warner Corp. Both prior to and since the war, he was assistant to the president of Zenith Radio Corp.

Charles Eisler, president of Eisler Engineering Co., Inc., Newark, N. J., and inventor, designer and machine builder, has received the degree of Doctor of Science from Bloomfield College, Bloomfield, N. J., for his "outstanding achievements in the incandescent-lamp and radio-tube industries."

Carl E. Scholz has been appointed vice president and chief engineer of American Cable & Radio Corp., and the Commercial Cable Co.

R. P. Clausen, formerly assistant chief engineer, has been named chief engineer of the Radio Tube Div., Sylvania Electric Products, Inc., Emporium, Pa.

Francis J. Gaffney and **Herbert A. Finke** have been elevated to the positions of general manager and chief engineer, respectively, of the Polytechnic Research and Development Co., Inc., Brooklyn, N. Y.

William P. Hilliard, formerly with the Bendix Radio division of Bendix Aviation, at Towson, Md., has been appointed to the newly-created post of director of engineering and research of General Instrument Corp. and its subsidiary F. W. Sickles Co.

Five new RCA-equipped stations in Mexico, Brazil, and Cuba, add television to the forces which make Good Neighbors of all the Americas.

Now television goes "Good Neighbor"

As little as 10 short years ago, television—to the average man on the street—seemed far away. Today, television is in 10,500,000 homes.

Newest demonstration of TV's growth is its leap to Latin America. Three RCA-equipped stations are now in Cuba, one in Mexico, another in Brazil—and more are planned. They are contributing to television progress by following a single telecasting standard. They also use developments from RCA Laboratories: the image orthicon television camera, electron tubes, monitoring equipment, and antennas.

And as our neighbors to the south watch television at home, they see another development of RCA research—the kinescope. It is the face of this tube which acts as the "screen" in all-electronic home TV receivers . . . on which one sees sharp, clear pictures in motion.

See the latest wonders of radio, television, and electronics at RCA Exhibition Hall, 36 West 49th St., N. Y. Admission is free. Radio Corporation of America, RCA Building, Radio City, New York 20, New York.

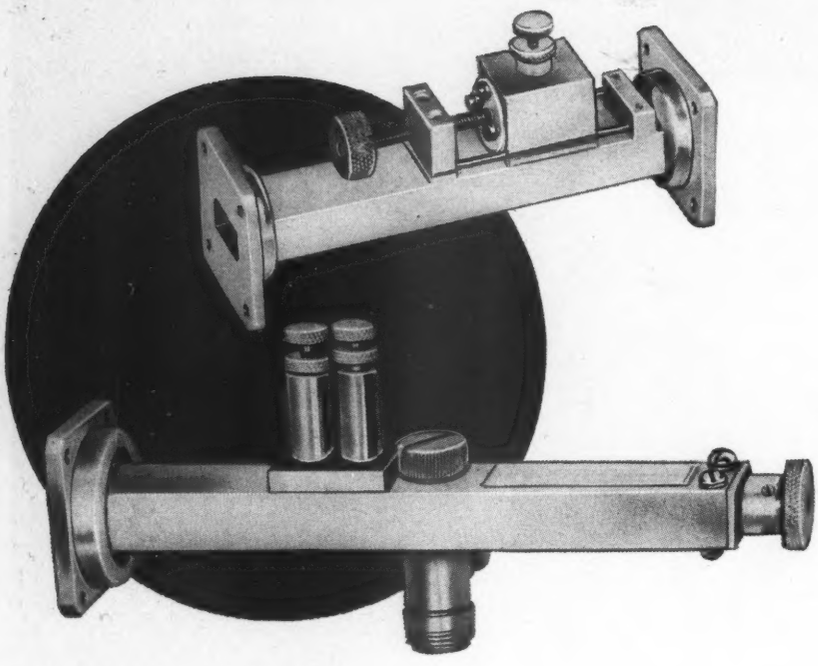
Results of RCA Research are seen in the magnificent pictures produced on the screens of the new 1951 RCA Victor home television receivers.

RADIO CORPORATION of AMERICA

World Leader in Radio — First in Television

KINGS

Microwave Equipment



KINGS proudly introduces a new and complete line of microwave equipment. Many improvements in design and construction are your assurance of the finest in precision instrumentation. Our engineering department is ready to cooperate on your most exacting microwave and research problems. Inquiries are invited.

KINGS MICROWAVE CO., INC.

50 Marbledale Road, Tuckahoe 7, N.Y.

an affiliate of Kings Electronics Company, Inc.

BOOKS

Travelling-Wave Tubes

By J. R. Pierce, Member Technical Staff, Bell Laboratories, Inc. Published 1950 by Van Nostrand Company, Inc., 250 Fourth Avenue, New York 3, N. Y. 260 pages. Price $4.50.

Here is the first thoroughly practical presentation of the fundamentals of traveling-wave tubes which restricts itself to those aspects which are most likely to remain in continuing importance.

Both the practical and theoretical sides are adequately covered and the introduction leads easily into the nature and applications as well as the method of operation of traveling wave tubes. Where required by the text, schematic diagrams are generously provided, and the subjects dealt with later in the book are based on the material so well handled in the earlier introductory chapters.

The practice of providing a synopsis of each chapter is heartily recommended as an aid to the busy engineer, for it enables the reader to decide whether the material he requires is in the chapter under consideration. The writing style is pleasant to read, and while the subject is not an easy one to handle without using pedagogic language the author has succeeded admirably in presenting an interesting illustration of the subject. Recommended to all users of traveling wavetubes and associated equipment.—J.H.B.

Television Receiving Equipment

By W. T. Cocking, published 1950 by Iliffe and Sons, Ltd., Dorset House, Stamford St., London, S. E. 1. England. 375 pages; price 18 shillings.

This is an interesting addition to the field of books dealing with television receivers and associated equipment. The author is exceptionally well known in England as a television authority and this book does much to enhance this standing. Although written from the British point of view, and therefore using terms which differ from those commonly used in the United States, it is nevertheless, a useful book for the television engineer in either country.

The book presupposes a thorough knowledge of radio and proceeds to build upon this to give the reader a full study of television. For this reason it is recommended in particular to AM radio engineers who are not yet in the television field but who hope to enter when the freeze is removed. The feature which appeals particularly to this reviewer is the sparing use of mathematics and restriction of this subject to areas where its understanding is essential. In view of the possibility of Anglo-US operations again being the order of the day the book offers an opportunity to become familiar with

British radio terms and at the same time improve one's television background.—J.H.B.

BOOKS RECEIVED

Elements of Single and Dual Track Magnetic Tape Recording

By A. C. Chaney. Published in 1950 by the Amplifier Corp. of America, (Twin-Trax Division) 398-26 Broadway, N. Y. 13, N. Y., this 5½ x 8½ booklet is composed of 128 pages and a 16 page supplement. Starting with a history of magnetic recording, the progress of the art is traced from the development of early tape recoders through to the perfection of the most modern dual-channel tape instruments. Available postpaid for $1.00 per copy.

Sylvania Tube Manual

Published in 1950 by Sylvania Electric Products Inc., Emporium, Pa., this 40 page booklet, 8½ x 11, provides a quick reference for substitutions of critical radio and television tubes. Available without charge from Sylvania distributors or by writing to Sylvania's Advertising Department in Emporium.

Telecommunications and Equipment in Germany (1939-1945)

British Intelligence Objectives, Sub-Committee Surveys, Report No. 29 Published in 1950, this 55 page booklet covers various aspects of the industry including research, transmission, instrument design and test equipment. It is available from British Information Services, 30 Rockefeller Plaza, N. Y. 20, N. Y. Price $0.40 per copy.

GE Microwave Equipment for Signal Corps

General Electric has received a $1,300,000 order from the U. S. Army Signal Corps for transportable microwave communications equipment. The equipment incorporates the best features of both radio and telephone communication. The order includes equipment for terminal and repeater stations, with complete standby equipment for each.

These radio stations will provide a number of communication systems, each capable of carrying eight telephone conversations in either or both directions at once, via a single radio channel for each direction.

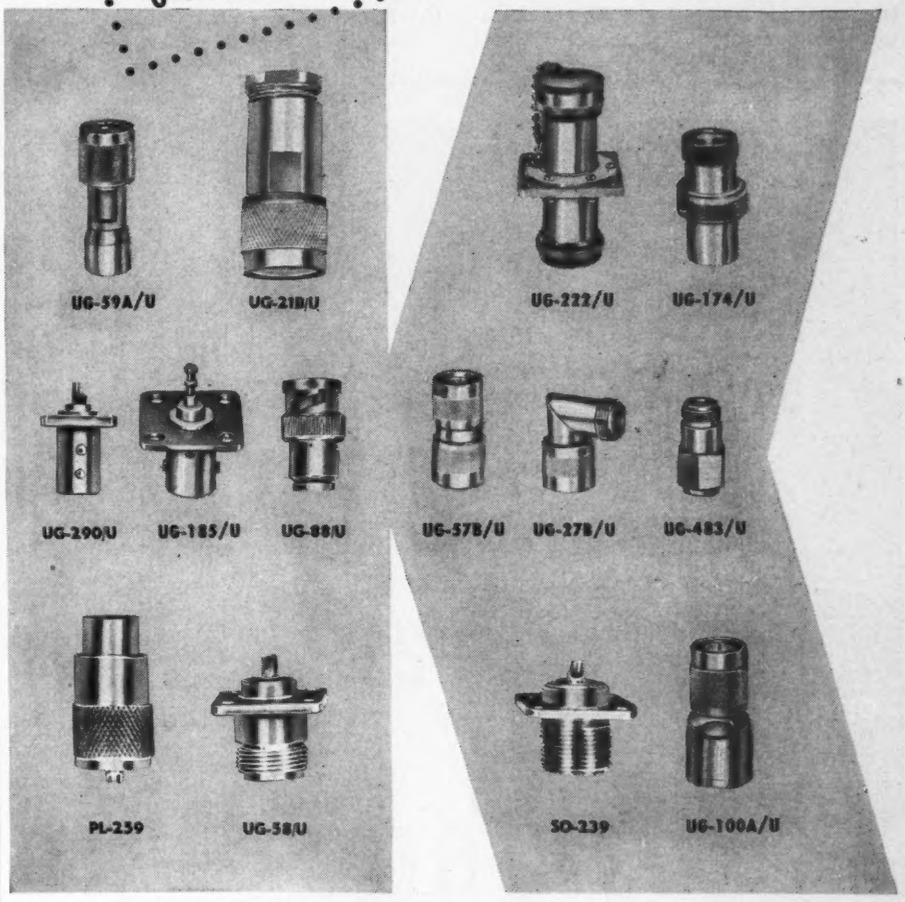
Silver-Circle Tuner Production

For the benefit of TELE-TECH'S readers interested in applications of printed circuits to television, we are presenting the important article on "Silver Circle TV-Tuner Design" which appears on pages 39-41 of this issue, although since that section of the issue went to press we learn that production of these units may be reduced or even discontinued by the Hoffman Company in the face of increasing military defense requirements.

Minnesota Luncheon During NY IRE Convention

A. G. Peck of CBS network operations, 485 Madison Ave., New York City, announces that during the IRE convention at New York, Minnesota men are invited to a luncheon at 12:30 p.m. Thursday, March 22, at Le Marmiton restaurant, 41 E. 49th St., when Dr. Henry Hartig will be toastmaster.

KINGS
COAXIAL CONNECTORS



preferred by engineers everywhere

From coast-to-coast, engineers in all fields look to Kings Electronics for the finest coaxial connectors.
Special problems in design and fabrication receive the wholehearted cooperation of Kings own engineering department.
For precision-made, pressurized R. F. Connectors call on Kings — the leader. Quotations on request.

KINGS Electronics

811 LEXINGTON AVENUE, BROOKLYN 21, N. Y.

High Frequency Measurements Conference

The second Conference on High Frequency Measurements, under sponsorship of the IRE and AIEE and the National Bureau of Standards held in Washington recently was attended by 550 radio scientists and engineers. The conference, under the direction of Prof. Ernst Weber, indicated a growing interest in this type of annual meeting where technical ideas are exchanged.

The meeting this year coincided with the 50th anniversary of the National Bureau of Standards and an inspection trip through some of the NBS laboratories on opening day permitted visitors to view standards of Attenuation, Impedance and Voltage usable at radio frequencies up to 300 MC; Dielectric Measurements; Standards of Frequency; Power Standards and Measurement above 3000 MC; Standards and Attenuation Measurements; Co-ax Resonance Line Impedance Measurements; Low-Level Power Measurements; Primary Freq. Standard in range of 300 to 40,000 MC where frequency is held constant to within 1 part in 100,000,000; Atomic-Beam Clock; Betatron Lab.; and the Eastern Automatic Computor.

The 28 technical papers presented can be grouped as describing the measurement of: Frequency and Time, Impedance, Power and Attenuation, Transmission and Reception. Considering the first subject it was interesting to note the progress made with the use of gas (ammonia) absorption lines for the stabilization and checking of microwave oscillators (23,870 MC), not only at the NBS but at Cruft Lab., Harvard, and RCA Labs. In the other subjects, progress is being made in extending the frequency limits upward in refining and making more precise equipment for measurements.

An evening session was devoted to three talks, each accompanying a demonstration. The first was a Stark-modulation type microwave spectrograph displaying absorption lines of ammonia gas on a projection oscilloscope, demonstrated by Rueger, Nuckolls and Lyons (NBS) and the second by Birnbaum, Kryder and Larson (NBS), was an instrument which records minute frequency differences between a test cavity and a reference cavity so that the atmospheric index of refraction at microwaves is recorded. A 2600-4000 MC VSWR Measuring Set described in an earlier session was demonstrated by Kaisel (RCA) and Kearney (AIL). Finally, (and to many the highlight of the meeting) was the demonstration of "Microwave Field Patterns Using Photographic Techniques" by Kock (BTL). The space patterns of microwaves and also centimeter sound waves were secured photographically by the use of a mechanical scanning method. The manner in which these waves could be refracted, diffracted and focused by iterative metallic structures was demonstrated.

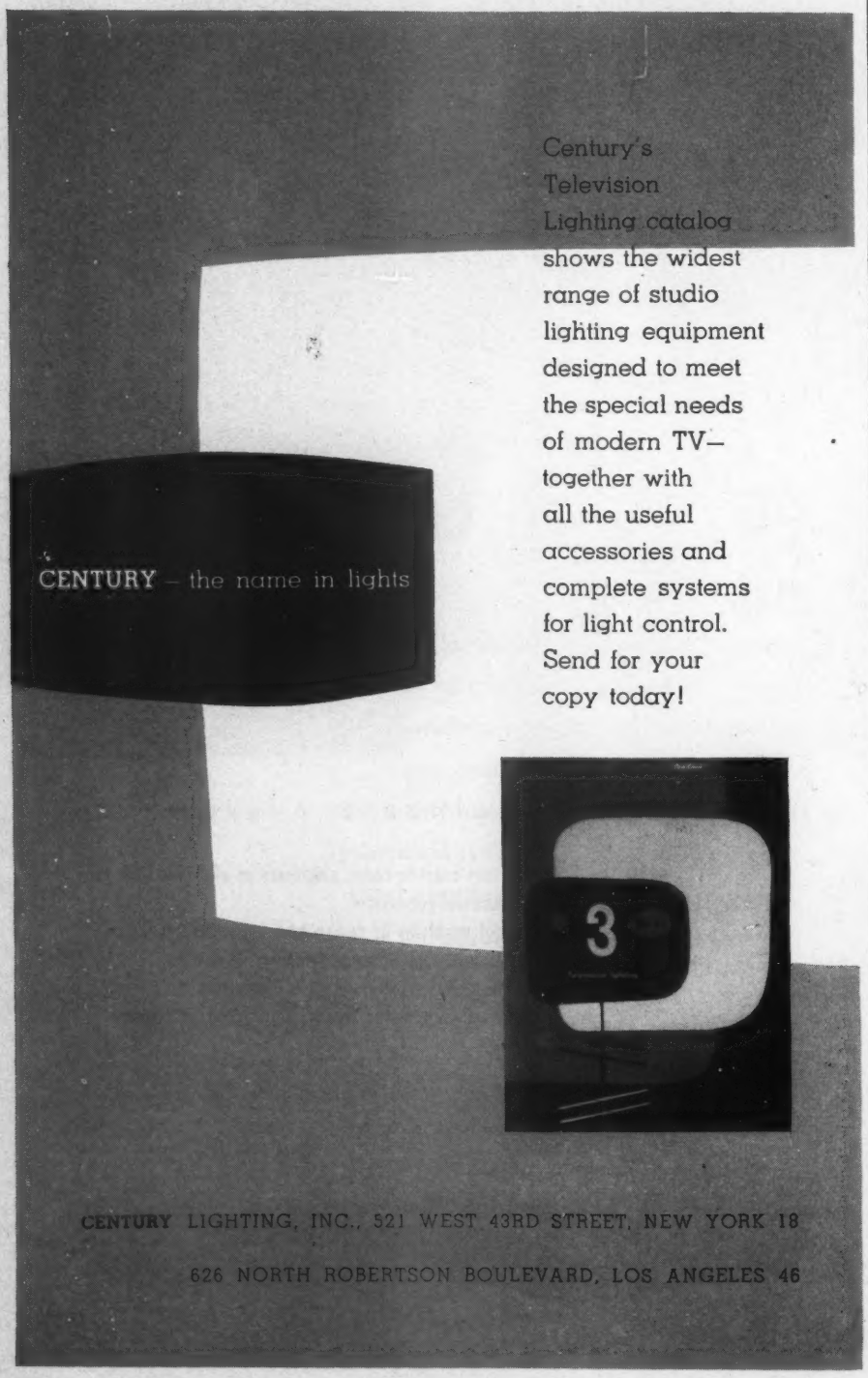
Other papers of interest to communication engineers included: "Millimeter Wave Measurements" by Gordy (Duke U.). Methods of generating, detecting and measuring millimeter waves, 30,000 to 150,000 MC.

"A 2600-4000 MC VSWR Measuring Set" by Kaisel (RCA) and Kearney (AIL). Presents an oscilloscope picture of VSWR looking into guide or co-ax over range 2600-4000 MC furnished by mechanical-swept reflex klystron.

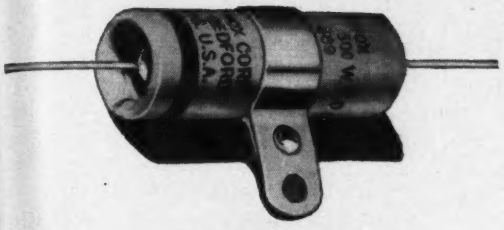
"Broadband Bolometer Development" by Waller (Poly Res. & Dev. Co.). Bolometers have been developed for 20-1000 MC, 1000-4000 MC and 4000-10,000 MC, having VSWR under 1.3 and dissipating 1 mw (low), 100 mw (high power).

"Measuring Techniques for Broad-Band Long Distance Radio Relays" by Albersheim (BTL). By rapid scanning, transmission characteristics such as gain, phase, impedance, etc., can be measured and traced on paper strips or cathode ray tubes.

Readers desiring more information on any of the papers presented at this Conference can communicate directly with the authors through Mr. Frank Gaffney, Polytechnic Research & Devolment Co., 202 Tillary St., Brooklyn, N. Y., who served as Chairman of the Technical Papers Program Committee.



temperatures going up...



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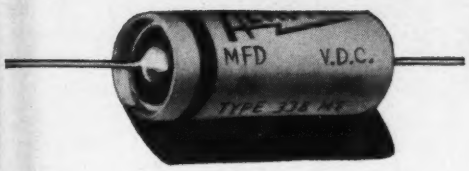

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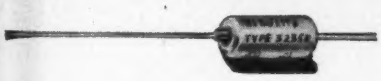

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LONGITUDINAL SLOTS

(*Continued from page* 44)

gave values of conductance agreeing with those obtained for the unpressurized horn. It will be noted that the susceptance introduced by the window has a negative slope with wavelength such that the overall susceptance is essentially flat. In this particular design half wavelength chokes were used to support the pressurizing window.

Radiation patterns of the longitudinal slots in circular waveguide are shown in Fig. 9. The H-plane pattern of a 1/16 X 0.619 in. slot in the 0.875 in. I.D. circular waveguide is 127° wide at 10 db down. This compares with the 134° beamwidth of a half-wave dipole. The pattern obtained when the waveguide is placed between parallel plates 1 inch apart is considerably modified. The main lobe has a 10 db beamwidth of 46° at $\lambda_o = 3.28$ cm and there are two prominent side lobes. The side lobe level decreases with wavelength from –5.5 db at $\lambda_o = 3.28$ to –13 db at $\lambda_o = 2.93$ cm. The pattern obtained with the same slot and an E-plane flared horn with total flare angle of 42° and a 1⅝ in. aperture is similar in the H-plane to the pattern of the slot alone having a 10 db beamwidth of 125°. The E-plane pattern with the horn is determined by the E-plane aperture and has a measured beamwidth at 10 db of 68° which is the same as the value calculated from horn design formulae.

Power Breakdown Characteristics

The breakdown power has been determined for the parallelogram slot feeding an E-plane flared horn with a pressurizing window for which the admittance characteristics are shown in Figure 8. A 2J55 magnetron operating with peak power output of 30 to 50 KW at 9368 MC (approximately the resonant frequency of the slot) was pulsed 1 microsecond at a repetition rate of 1000 pps. It was necessary to evacuate the line to 250 mm Hg. absolute pressure to obtain breakdown. An arc appeared first across the center of the slot and when arcing became continuous the intensity of the arc varied somewhat sinusoidally across the width of the slot.

Breakdown tests were also made at atmospheric pressure using a 4J50 magnetron pulsed 1 μ sec. at 1000 pps. Arcing began across the center of the slot at 137 KW peak and became continuous at 171 KW peak. Power was measured by means of directional couplers and a thermistor bridge calibrated against a water load.

From data given by Ragan the breakdown power for the ⅛ in. wide slot under the test pulse conditions has been calculated to be 61 KW. The dc breakdown voltage of the slot has been calculated to be 9.5 KV, an equivalent of 46 KW of power. The slot has been proved to be capable of handling power considerably in excess of the theoretical breakdown.

New Signal Corps Depot in Pennsylvania

The Department of the Army announced recently that construction will start in the Spring on a new Army Signal Corps depot on a 1,400-acre tract at Tobyhanna, Pennsylvania, near Scranton and Wilkes-Barre. The land on which the new depot will be built is a former military reservation, now owned by the State of Pennsylvania. Plans call for completion of the new depot early in 1953. The installation will be of permanent construction, including approximately 2,000,000 square feet of storage space.

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LETTERS...

Louis W. Parker's Intercarrier System of TV

Editors, TELE-TECH:

In your December, 1950, issue, the article on "High-Definition Monochrome TV" by Franklin Loomis on page 52 makes reference to the "Inter-Carrier Method of TV Reception." The Intercarrier System was invented by my client, Louis W. Parker, and is protected by his patent No. 2,466,908. Radio Corporation of America and its sublicensees are licensed under this patent, and General Electric Co., is of course operating under this license. As far as I am aware, Mr. Parker's status as inventor has never been questioned.

It is therefore unfortunate that there should be implied to anyone else the credit for originating the Intercarrier System, especially as Mr. Parker's material contribution to television has not, in my opinion, received the general recognition to which he is entitled.

GEORGE G. HYDE
Attorney-at-Law
41 Park Row
New York 7, N. Y.

Working Conditions of Federal Employees

Editors, TELE-TECH:

The item "Happy Sick-Leave" on page 14 of November TELE-TECH, contains a series of misstatements with respect to the leave rights of Federal employees; rights, it should be emphasized, which have been established through legislation overwhelmingly approved by Congress as the culmination of many decades of practical experience. The present 26 days of annual leave, moreover, are a reduction from the 30 days provided under former legislation. But this still does not mean that all employees actually get even 26 days of annual leave because work requirements vary frequently, and increasingly make that impossible.

In addition, whereas millions of employees in private business and industry take time off for visits to doctors, shopping, attending funerals, and the like, without the loss of either leave or pay—every hour, every half-hour, taken off by Federal employees is charged against their annual leave; and tardiness, too, is similarly a charge against leave.

Although, in keeping with progressive personnel practice, Congress has authorized 15 days of sick leave, the records show that the average amount of sick leave taken annually by all Federal employees is just about half that total.

You state in your article that "in many government bureaus it is customary to treat sick leave as 'extra' annual leave." That is no more in accord with the facts than the remainder of the piece. Sick leave is authorized for that purpose and that purpose alone; employees are specifically required to furnish evidence of illness in all cases. It is possible, of course, that there are occasional abuses; we do not claim either for Federal employees or Federal administrators the quality of infallibility.

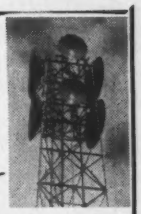
In conclusion, it should be pointed out that the Federal Government is probably the only employer in the country which today is working employees longer hours than before World War II. An hour has been added to the work week, which means that Federal employees today are working the equivalent of 6½ days additional each year.

LUTHER C. STEWARD,
President, National Federation of Federal Employees,
1729 G. St., N.W.,
Washington, D. C.

British Radio Components

Harold Ellis, with offices at 366 Madison Ave., New York 16, N. Y., is arranging to represent several British leaders in the radio-component manufacturing group to promote sales to American manufacturers and parts distributors. The new British Electronic Group, as it will be known, expects to commence deliveries during April for most products.

"Prodelin"



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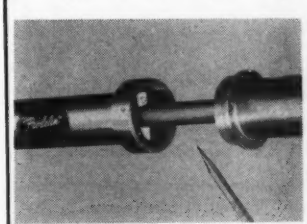

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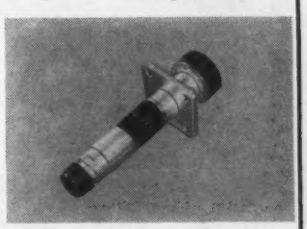

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Defense Contracts

(*Continued from page* 33)

ices are organized on somewhat similar lines. There is a general staff. There are planning divisions, design and development divisions, engineering requirements divisions, research divisions, contracting divisions, contract administration, etc. The organization varies and the names and titles are not always identical between military services, but their functions are the same.

The planning people determine overall requirements. The design and development, and the research divisions, are interested in new equipment and projects, in ideas, in improvements. The engineering requirements people work out the specifications. A manufacturer should talk with the engineer (usually a civilian), employed by the military and responsible for a particular item or component, in order to determine the suitability of his product. This engineer's recommendations, and his advice are passed on to the contracting officers.

A Selling Job

It all adds up to the fact that you have a selling job to do. You must sell yourself, your product, your facilities and confidence in your plant all along the line—to design and development people, to the product engineers and to the contracting officers.

If your selling is done with the aid of a brochure, make it specific, complete and attractive. It may also be done effectively by advertising in technical magazines with circulation where it counts. In your personnel calls, visit the contracting officer *and* the engineers who advise them.

When you succeed in getting a contract or are invited to bid on a contract, be sure to get all available information and specifications. Don't hesitate to discuss the meaning or intent of contract clauses or manufacturing specifications with the contracting officer. File your bid as prescribed. You do not have to be present when bids are opened, although it sometimes affords an opportunity to size up your competitors or pick up helpful information from the contracting officer or to gauge his thinking.

Although you may have complied with the routine requirements in registering with military procurement agencies, concentrate your greater efforts on subcontracting. That's where your immediate opportunity lies.

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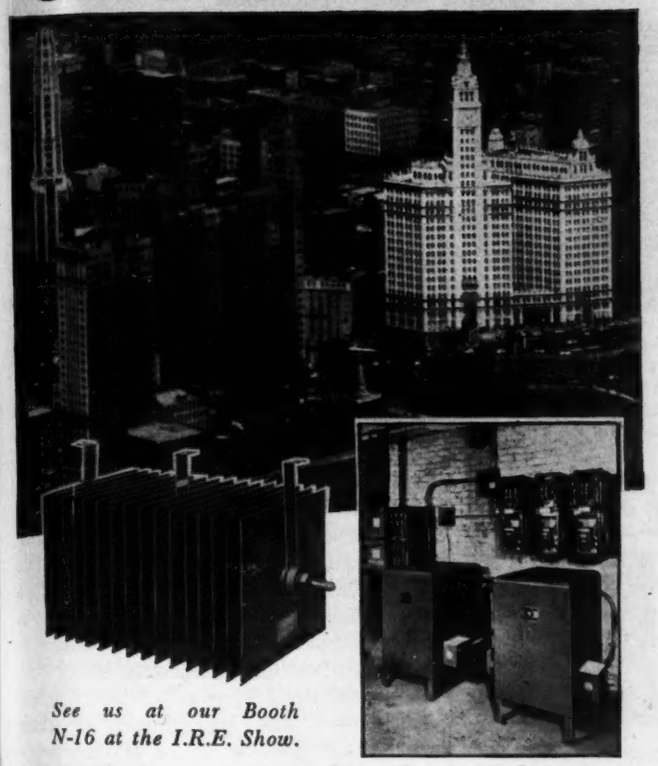

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Of course, elevator operation is but one of *many* uses for SELETRON. These rugged, efficient selenium rectifiers are versatile—useful in hundreds of varying industrial applications for economical conversion of alternating current to D.C.

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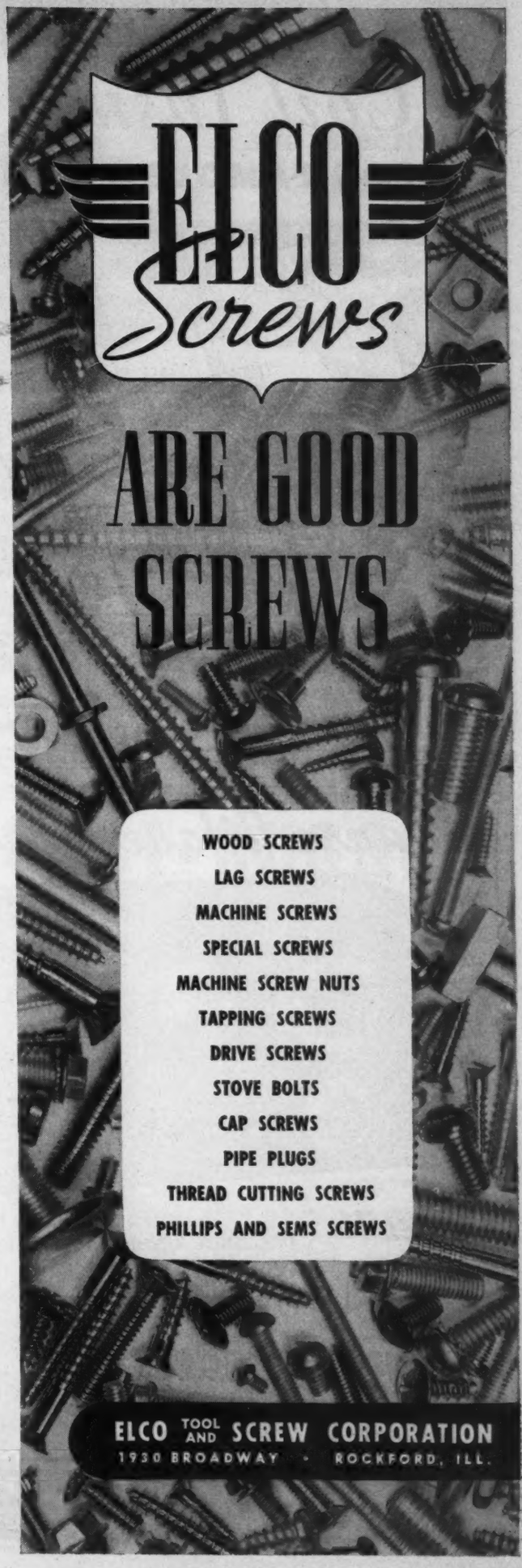

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SPECIFICATIONS

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R. F. MODULATOR: 5 volts maximum carrier input. Translation gain is approximately unity—Output impedance is 600 ohms.
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TV Sound Diplexer

(*Continued from page* 35)

models, a rack-mounted unit suitable for fixed installations and mobile use, and a compact, lightweight unit mounted in a carrying case for portable applications.

The rack-mounted model, shown in Fig. 2, is 19 in. wide, 12¼ in. high, and 12¾ in. deep. The rear dust cover is interlocked. The front panel carries a circuit breaker and two meters. One is the volume indicator for percentage modulation, and the second, in conjunction with an 11-position switch, serves to check the current and voltage levels at essential points as well as the drift of the center frequency from the reference value.

Among the controls brought out on the front are a 3-position switch that facilitates various alignment and adjustment procedures. When the equipment is set up, the switch is positioned so that the volume indicator shows the amplitude of the input audio-frequency signal, which should not exceed the maximum of 10 db. The switch is then thrown to a second position and the modulation level control is adjusted to effect full modulation as shown by the volume indicator; the equipment is then ready for use. A third switch position makes possible the over-all alignment of the submitter. The discriminator may be adjusted by employing the free-running oscillator-modulator as an electronic sweep generator covering a band approximately 400 KC wide.

The compact portable submitter unit, shown in Fig. 2, measures only 14 in. wide, 9 in. high, 8 in. deep, and weighs but 16 pounds. All controls are accessible when the equipment is set up; they are protected during operation by a hinged cover plate. Electrically it is identical with the rack-mounted model, except for the absence of the multiposition metering switch. One front-panel meter is permanently connected to read center frequency, while the volume indicator shows either percentage modulation or audio-frequency input level.

This receiver consists of a filter to separate the video and frequency-modulated signals, a 5 MC amplifier, cascade limiters, balanced discriminator, low-pass filter, and an audio-frequency amplifier. Additional circuit features are automatic volume control and squelching of the audio-frequency amplifier in the absence of a frequency-modulation signal.

As mentioned before, cross-talk from the video signal into the sound channel can result from incomplete

rejection of amplitude modulation in the subceiver and from nonlinear phase characteristics of the relay system. Substantial ampliture modulation of the frequency-modulated signal at the video horizontal-line frequency (15,750 cps), is introduced by various components of the radio link. In addition, the synchronizing pulses fall at one extremity of the relay-system pass band, where the phase characteristics tend to be particularly nonlinear.

To eliminate these high-frequency cross-talk components, a low-pass filter is incorporated in the subceiver. The cut-off frequency (3 db down) is at 12,500 cps, and the point of maximum attenuation is at 15,750 cps. This is illustrated in Fig. 3.

The subceiver is available as a rack-mounted unit of the same overall dimensions as the rack-mounted submitter. A photograph is shown in Fig. 4.

The front panel carries a microammeter, which, in conjunction with a multiposition switch, permits checking of all important voltages and currents. A set of contacts on the squelching relay operates a front-panel amber lamp to indicate the presence of a frequency-modulated signal. Another set of contacts on the same relay provides for remote indication.

The *FTL-38A* equipment has been subjected to rigorous tests over a number of commercial television links. The residual crosstalk was found to depend largely on the phase characteristics of the particular relay system and generally manifested itself in the form of a 60-cycle spike. The root-mean-square value of this cross-talk signal could be reduced without difficulty to be smaller than 50 db below the rated subceiver output and the peak-to-peak amplitude to smaller than 40 db below rated output. This compares favorably with the performance obtainable over present-day intercity telephone lines.

Powder Metal Firm To Larger Quarters

Sintercast Corp. of America, an organization specializing in powder metallurgy, has moved its office, laboratory and production facilities from New York City to larger quarters at 134 Woodworth Ave., Yonkers 2, N. Y. Until its recent acquisition of the business and equipment of the Wright Carbide Co., East Orange, N. J., Sintercast was primarily a research and development organization. However, the activities of the firm now are: research into and development of new powder metallurgy techniques and alloys; and production of standard and special-purpose powder metal parts.

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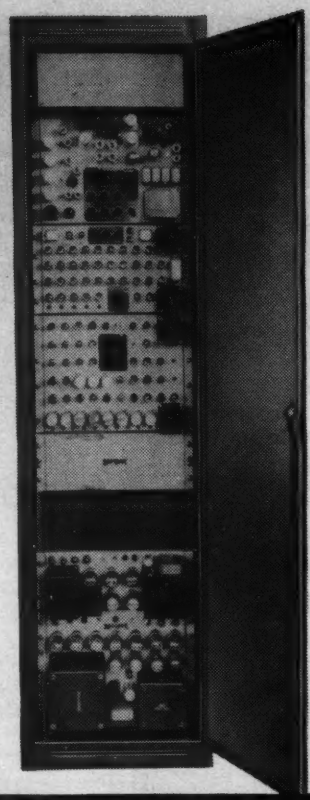

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TV SHOWN IN SWEDEN

Sweden's Prime Minister, Tago Erlander (second from left), and Air Force General Nordenskiold (left) examine an RCA television camera. In center, rear, is Sven Jannson, director of Elektronikbolaget, RCA distributor in Sweden. Explaining details is RCA engineer, Walter Lawrence.

Teletronics Products Now Made by U.S.E.C.

U. S. Electronics Corp., 2038 Broadway, Santa Monica, Calif., has started to manufacture and distribute telephone recording induction coils formerly made by Teletronics, Inc., Culver City, Calif., according to J. A. Wolvin, U. S. Electronics president. Teletronics was dissolved in January.

EMC Doubles Space

Electronic Measurements Corp., formerly of 423 Broome St., New York City, has announced the removal of their offices and factory to 280 Lafayette St., New York 12, N. Y. The new quarters will afford EMC twice the floor area for manufacturing facilities, and will allow them to meet the demand for their electrical test equipment.

Condenser Products Moves After Fire

On January 12th, within twenty-four hours after a fire destroyed most of their factory at midnight on January 10th, Condenser Products Co., Chicago, signed a lease for new and much larger quarters. The office records and most of the engineering records are intact and manufacturing is underway at the new quarters, 7517 North Clark St.

The fire broke out in the building adjacent to Condenser Products Company and rapidly spread to their plant. All of the equipment was destroyed.

M. H. Levenberg, president of the firm, expressed his appreciation to the industry when he said, "it is gratifying to have received so many calls from customers, suppliers, representatives and competitors, offering to assist us in any way possible. I am especially appreciative to other condenser companies who offered equipment and badly needed materials to assist us. We will be going full blast in a few short weeks and our new, much larger quarters should enable us to catch up in the near future."

Time and Frequency

(*Continued from page* 38)

signals. The 1000-cycle phase-shifter of the local standard is adjusted until the earliest seconds pulse from WWV also starts at the reference mark. (This adjustment of the phase-shifter does not change the phase relationship between the local 60-cycle frequency and the local seconds pulses, both of which are obtained by dividing the 1000-cycle frequency *after* passing through the phase shifter.)

The time of arrival of the seconds pulses from WWV will occasionally vary up to 5 milliseconds, indicating a variation of path-length between Washington and Maui up to 1000 miles. The earliest pulse to arrive is considered the one which followed the shortest path. Computation for 3-hop transmission shows that the shortest path between WWV and WWVH, 4800 miles on the surface, would cause a delay of 0.027 second. At the setting of the phase-shifter for agreement with the received signal the local clock is set 0.027 second slow with respect to WWV. For broadcast purposes the phase-shifter is then advanced 0.027 second from the setting at which it agreed with the received signal from WWV to synchronize the seconds pulses as transmitted from the two stations. (The phase-shifter dial is graduated in 0.01 millisecond divisions.)

The average frequency error in terms of WWV is determined by dividing the change in the phase-shifter setting for synchronizing with WWV by the number of seconds in the period during which the change took place. The basic period for the computation of the frequency at station WWVH is six days for the daytime and five days for the nighttime determinations, the value so computed being the frequency error for the middle day of the period. Such a computation is based on the time at WWV being correct. For example: suppose that on the morning of November 4 the phase-shifter setting was 0.346 second and on November 10 it was 0.343 second. The change in setting is +0.003 second in 6 days. The average frequency error then is equivalent to an error of +0.00058 CPS and the frequency is 100,000.00058 CPS which is the frequency for November 7. An extrapolation of the plot of these frequencies will indicate when the local standard should be adjusted to maintain the agreement with WWV.

At times it becomes necessary to adjust the frequency of the standard

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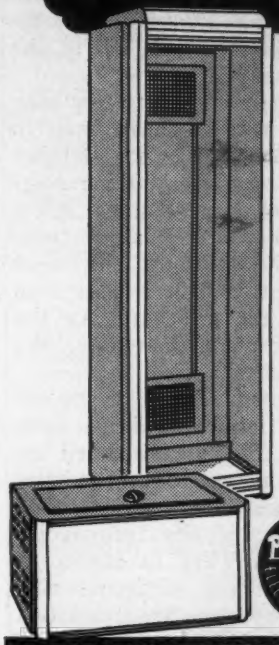

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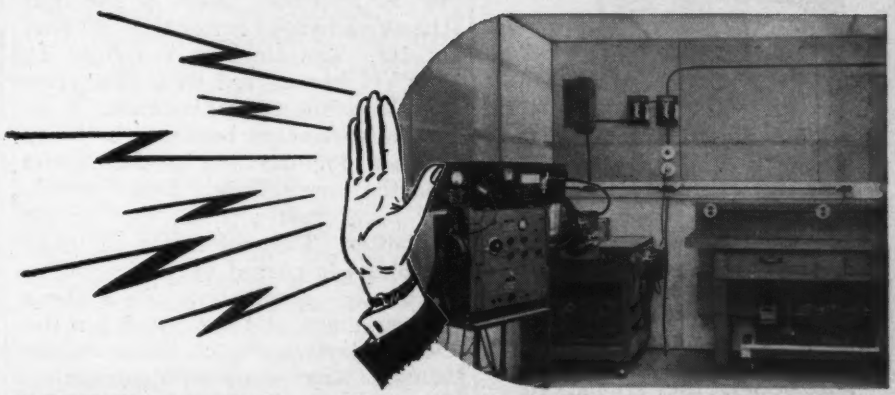

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oscillator controlling the frequency at station WWV to compensate for normal drift. Extrapolation of the frequency curve for this standard indicates when such adjustment should be made and a radiogram is sent to the Maui station two days before the adjustment to state the date and magnitude of such adjustment to be made simultaneously at both stations. Such adjustments, ordinarily made once a week, are of the order of —1 part in 10^8.

The main and standby frequency standards at WWVH have been in continuous operation since October 1948 and the spare only since August 1949. Occasionally short interruptions have occurred since then. At present the drift of the main and standby standards is less than +2 parts in 10^9 per day. As the length of operation increases, the drift will become less.

Since November 23, 1948, the operation of station WWVH has been continuous except for scheduled interruptions and occasional power failures. Figure 3 shows a graph of the daily error of the frequencies broadcast by WWVH in terms of WWV. Adjustments of frequencies are indicated by the discontinuities of the curve. The agreement of WWVH is better than ± 2 parts in 10^8 at all times. Most of the time the agreement is better than ± 1 part in 10^8. The time as broadcast by WWVH has agreed with that from WWV within ± 2 milliseconds.

The agreement between the 6-day periods for daytime measurements and the corresponding 5-day periods for night values is ± 1 part in 10^9 or better. This difference in many instances is caused by the rounding off in the computation. As a check the data are also computed for the 2-day daytime and 3-day night values. Any error in determining the time-agreement values caused by personal error or change in the height of the ionospheric layer would be expected to cause more variation in the value for the shorter periods. However, the disagreement between the value of frequency for a particular day based on a 2 or 3-day period and that for the 6-day period has been 0 to ± 3 parts in 10^9, the majority of disagreements being 0 or ± 1 part in 10^9.

Since the service was started from Maui the frequency and time as broadcast were maintained in agreement with those broadcast from radio station WWV. As may be seen in figure 3, the agreement in 1949 was better than ± 2 parts in 10^8; it was better than 1 part in 10^8 86% of the time. The agreement in time

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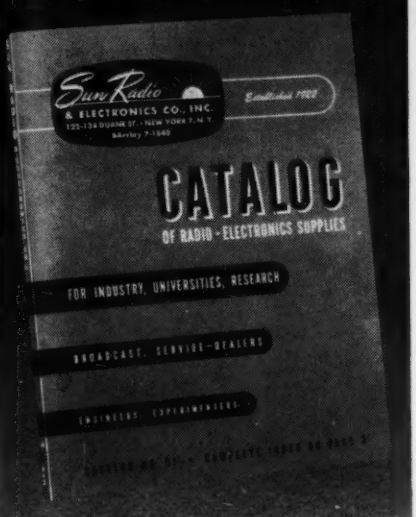

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has been within ±2 milliseconds at all times. With best performance of the present-day quartz-crystal oscillators, there should be little difficulty in maintaining widely separated radio stations in frequency agreement to a few parts in 10^9.

REFERENCES

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5. Inospheric radio propagation, Circular 462, available from Superintendent of Documents, G.P.O., Washington 25, D. C. (price $1.00; foreign $1.25).
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Pocket Receivers Introduced for Radio Call System

Telanserphone Corp. of New York City has commenced operation of a radio call system which contacts anywhere within a 25 mile radius of the transmitter, and in favorable conditions at considerably greater distances.

The transmitter KEA627, made by Erco Radio Laboratories of Garden City, N. Y., operates on 43.58 MC. It has a power rating of 250 watts, is amplitude modulated and operates into a double-stacked coaxial antenna with a gain of about 1.5 times. The transmitter is situated on the top floor of the Pierre Hotel.

Weighing only 7 oz., the receiver measures approximately 6 x 2 x 1 in. Full circuit details have not been disclosed pending patent action, but it is understood to use subminiature tubes in a superregenerative circuit. "A" and "B" supplies of 1.5 v. and 30 v. respectively last four to six months with normal use.

The method of operation of the actual call system is foolproof and unique in design and operation. Basically, it consists of an endless conveyor chain which takes one minute to pass through the machine. Every subscriber has a personal number photoelectrically recorded on a 16mm movie film strip which is encased in plastic. Each strip has a hook for attaching it to the chain. When a call for a subscriber is received the operator merely looks up his call number and places the strip containing it on the chain. Once every minute it passes in front of the photoelectric cell and the number is transmitted. This continues until the person called telephones the Telanswerphone office. The "Mechanicall," as it is called, was designed and manufactured by Reeves Soundcraft of New York City.

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Propagation Measurements

(*Continued from page* 51)

the visual carrier. The signal generator was then connected to the converter input through a suitable matching transformer, and values of signal generator output voltage corresponding to various values of receiver AGC voltage were recorded. A curve of this data is shown in Fig. 5. The signal generator output voltage is expressed in both db below 0.1 volt across 50 ohms, as read directly from the attenuator dial, and in corresponding db above 1 μ v. This voltage is also the converter input terminal voltage, as measured across an impedance level of 50 ohms.

The field intensity corresponding to a given value of receiver AGC voltage E_{agc}, was determined by means of the relation:

$$E = E_1 + 20 \log \left(\frac{2\pi \sqrt{Z_r/Z_1}}{\lambda}\right) - G_r + A$$

where E Field Intensity (db above 1 uv/m)

E_1 Converter input terminal voltage corresponding to the given value of receiver E_{agc}, as determined from Fig. 1 (db above 1 uv/m across Z_1)

Z_r Radiation resistance of a half wave dipole (ohms)

Z_1 Impedance across which E_1 was measured

λ Wavelength (meters)

G_r Gain of receiving antenna over a half wave dipole (db)

A Transmission line attenuation (db)

Substituting:

$Z_r = 73$ ohms
$Z_1 = 50$ ohms
$\lambda = 0.591$ meters
$G_r = 6.3$ db
$A = 2.5$ db

$$E = E_1 + 22.2 \text{ db} - 6.3 \text{ db} + 2.5 \text{ db} = 18.4 \text{ db} + E_1$$

The gain of the Yagi receiving antenna over a half wave dipole was measured by mounting a reference dipole on a 10-ft. pole in a location relatively clear of surrounding objects. The dipole was moved over a distance corresponding to several wavelengths along a path in line with the transmitter. Maximum and minimum values of receiver automatic gain control system voltage were recorded. The Yagi antenna was then mounted on the same pole and moved over the same path, maximum and minimum values of AGC voltage again being recorded. The gain of the Yagi was defined as the ratio of the mean value of converter input voltage obtained with the Yagi to

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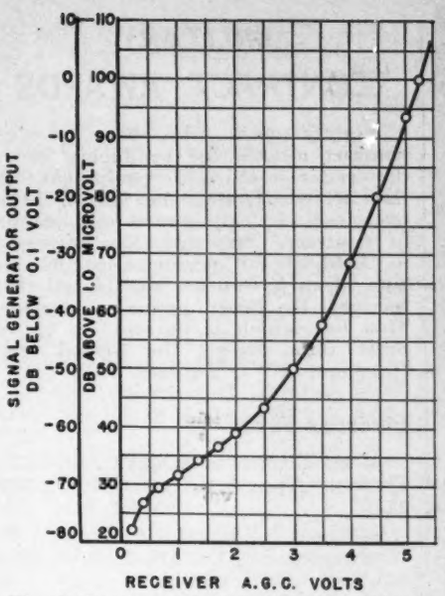
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110 100 90 80 70 60 50 40 30 20
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Fig. 5: Input to receiver from signal generator plotted against agc voltage.

the mean value obtained with the dipole.

	Yagi Min.	Yagi Max.	Dipole Min.	Dipole Max.
E_{agc} (volts)	3.78	3.82	3.45	3.7
E_1 (db above 1 μv/m)	63.8	64.2	57.0	61.8
E_1 (microvolts)	1549	1622	708	1230
Mean E_1 (microvolts)	1585.5		969	

This is a ratio of 4.3 db. Since the attenuation of the transmission line employed with the dipole was 0.5 db, and that for the Yagi was 2.5 db, a factor of 2.0 db must be added to this ratio, yielding a net gain of 6.3 db.

Part Two will appear in the April issue.

Fire Destroyed Wells Sales Showroom

Five million people are said to have watched the spectacular blaze that destroyed the big warehouse just outside Chicago's loop on Friday, January 12th. The burning building was within camera range of three television network stations, consequently, it was the first on-the-scene television coverage of a disaster to be carried by entire networks.

Wells Sales, Inc., well known suppliers of radio and electronic components to the industry, occupied two floors of the building. The entire showroom inventory and a large stock of tubes were a total loss.

However, the greater portion of Wells Sales inventory had been stored in three other warehouses and business is now being resumed from the new location at 833 W. Chicago Avenue, Chicago 22, Illinois.

Bob Whan, president of Wells Sales, Inc., thanks his many friends who have generously cooperated in getting his organization back into operation.

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MILITARY CONTRACT AWARDS

Manufacturers who have received contract awards for producing of radio - radar - electronic equipment for the Armed Services are listed below by name, city, equipment and amount of contract. Subcontractors interested in bidding on performance of any part of each contract should sell their services to these prime contractors. This list, which is current up to our press time, covers the period from December 28 to January 31.

Electron Tubes

Anton Electronic Lab. Inc., 1226-1238 Flushing Ave., Brooklyn 6, N. Y., $37,-250.

Chatham Electronics Corp., 475 Washington St., Newark 2, N. J., $294, 750.

Allen B. DuMont Labs., Clifton, N. J., $71,875.

General Electronic Co., Electronics Dept., Schenectady, N. Y., $915,900.

Litten Industries, San Carlos, Calif., $2,000,000.

Machlett Laboratories, Inc., 1063 Hope St., Springdale, Conn., $627,000.

National Union Radio Corp., Orange, N. J., $119,527.

Raytheon Mfg. Co., Power Tube Division, 138 River St., Waltham, Mass., $217,500.

Sylvania Elec. Prods., Boston, Mass., $1,250,000; Sylvania Elec. Prods., N. Y., N. Y., $256,000.

Other Equipment and Components

Air Associates, Teterboro, N. J., 381 radio receiving sets, $405,600.

Air King Prods., Co., Brooklyn, N. Y., 1,561 wire recorders, type 1C/VRW-7, $600,000 (approx.).

Bendix Radio, Div. Bendix Avia. Corp., Baltimore, Md., receiver-transmitters, $1,559,237.

Bendix Radio Div. of Bendix Aviation Corp., Towson, Md.; 63 AN/URD-2 direction finder equipment, $350,000 (approx.).

Bird Electronic Corp., Cleveland, Ohio, 305 ME-11/U radio, frequency wattmeters, $77,148.23.

Espey Mfg. Co., New York, N. Y., 185 ac motors, $41,209.

Federal Mfg. & Engrg. Corp., Brooklyn, N. Y., 365 AN/URM-25 radio frequency standard generator, $201,354.91.

Federal Telephone & Radio Corp., Clifton, N. J., components of AN/GRC -3 thru 8 series (items 1 thru 63), $27,300; 267 Navy Model RBA class 1 radio receivers, $800,000.

General Electric Co., New York., N. Y., 140 parallax amplifiers, $38,640.

General Elec. Co., Schenectady, N. Y., position indicators, $41,215; voltage regulators, $40,637.

Hoffman Radio Corp., Los Angeles, Calif., 591 radio sets, $600,000.

Hytron Radio & Electronics Corp., Salem, Mass., 300,000 rocket electrical connectors, $196,374.

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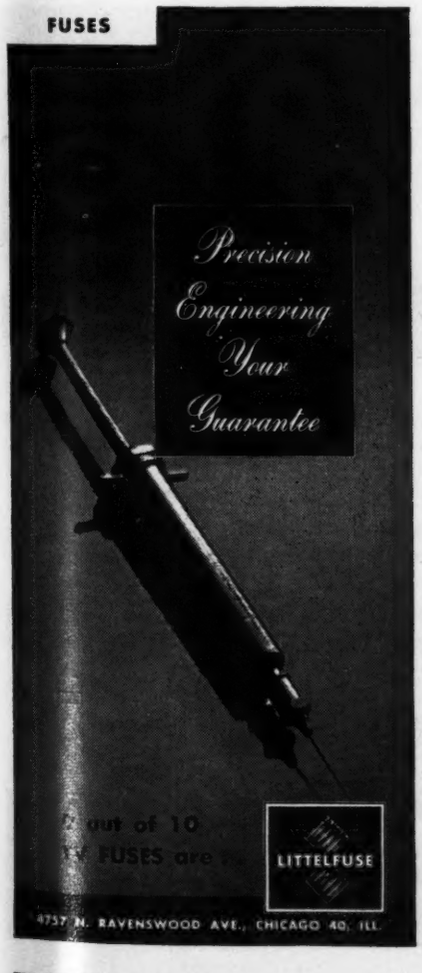

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Elmhurst, N. Y., machometers, $338,-164; airspeed indicators, $108,923.

Johnson Service Co., Milwaukee, Wis., 75,000 radiosondes, 6 tabular lists of parts, 1 mfr's. Sig C dwg., $3,041,250.

Lewyt Corp., Brooklyn, N. Y., 1,634 radio sets, $1,732,291.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., automatic pilot components, $2,000,000.

Molded Insulation Co., 335 East Price St., Philadelphia, Pa., Radioson de An/AMT-2, $1,476,110.

Philco Corp., Philadelphia, Pa., microwave systems, $1,500,000.

Radiomarine Corp. of America, New York, N. Y., radar equipment, $23,-333.31.

Raytheon Mfg. Co., Gov't Contract Dept., Waltham, Mass., 45 network pulse delay, $25,560.

Sperry Gyroscope Co., Great Neck, N. Y., flight computor system, $6,105,-000.

Specialty Assembling & Packing Co. Inc., 79 Clifton Place, Brooklyn 5, N. Y., Radion Set An/CRD-2, $182,486.

Technical Appliance Corp., Sherburne, N. Y., 2,180 antenna, $58,314.

Webster-Chicago, Chicago, Ill., parts for recorders and playback, $68,648.

Western Elec. Co., New York, N. Y., control assemblies, $51,834.

Westinghouse Elec. Corp., Baltimore, Md., 21 rectifiers, metallic cell, $25,000.

Wilcox Elec. Co., Kansas City, Missouri, receiver-transmitter, $621,741.

Engineer Consultants to Ad Hoc Policy Committee

Former FCC Commissioner E. K. Jett, vice president and television director of Baltimore Sunpapers, and Haraden Pratt, vice president and Chief Engineer of American Cable and Radio Corp., have been appointed consultants to Ad Hoc Committee attending the extraordinary Administrative Radio Conference to be held in Geneva in August.

The conference was originally planned to ratify the Provisional Frequency Registration Board allocations resulting from the 1947 Atlantic City Radio Frequency Allocation Table. After the latter meeting the participating countries were required to prepare tables of frequencies which they would require for their operations; these were then to be approved by the Geneva meeting and become the basis of the International Frequency Registration Board.

Unfortunately, many countries prepared demands which would need more space than is available, hence the appointment of this country's top engineers to advise the administrative committee dealing with the problem. The Conference is concerned only with frequencies from approximately 3 MC to 25 MC which are used for international communication. Thus, broadcasters in this country will not be affected by its deliberations although international broadcasting operations such as the Voice of America, and commercial telegraph companies may have to change some of their frequencies as a result.

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Raytheon Wins Magnetron Priority

Priority of invention of basic magnetron strapping has been awarded by the United States Patent Office to Dr. Percy L. Spencer, vice-president in charge of the power-tube division of the Raytheon Manufacturing Company in Waltham, Mass. This action was based on concession of priority for the United States by Dr. James Sayers of England. This tribute to Dr. Spencer's genius marks the end of an extended interference contest in the United States Patent Office.

The basic idea of tying alternate oscillators in a cavity magnetron to improve mode separation and increase efficiency was first conceived by Dr. Spencer during the early part of 1941. This concept played an important part in making the magnetron a powerful and reliable generator and thus the basic element for countless radars, fire-control systems and other electronic weapons used in World War II. These vital devices are of increasing importance today.

This invention is one of a score of significant contributions Dr. Spencer has made in the electronic field. His work on the proximity fuse, lamination of magnetrons to permit mass production and the development of various types of continuously tuned magnetron systems has been recognized by various national citations culminating in the Navy's highest civilian award.

Dr. Percy L. Spencer. Raytheon vice-president, who gets priority recognition in magnetron patent case

Crest in Pacific Northwest

The Crest Transformer Corp. of Chicago, Ill. has appointed H. D. Widdekind of 9004 W. Shorewood Drive, Mercer Island, Wash. as representative for their electronic, radio and television line of transformers. According to R. J. Arndt, sales manager for Crest, Mr. Widdekind will cover the Northwest territory including Montana, Idaho, Oregon, Washington, British Columbia, and Alaska.

Corning Glass Works Building Research Facilities

The Centennial of the Corning Glass Works, Corning, N. Y., will be celebrated this summer with the opening of comprehensive facilities for research and education in glass. The two-story building will have over 100,000 sq. ft. of floor space and will contain, in addition to a library and museum, lecture and study rooms, facilities for employee activities and a 2,000-seat auditorium for company and community purposes.

RMC Opens Second Plant

The grand opening of an RMC plant located in Attica, Indiana was held recently, according to an announcement by J. F. Riley, president of Radio Materials Corp. Located on a 30 acre tract, the new plant covers 50,000 square feet of which 20,000 is now in use.

Government Control of Electromagnetic Radiation

Under the guise of war exigency the Defense Department has caused to be introduced in the Senate on January 17, a bill which would place the control of anything capable of emitting electromagnetic radiations from 10 kc to 100,000 MC in the hands of the president.

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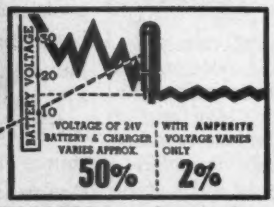

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Senator Edwin C. Johnson offered the bill to the Senate, but emphasised that he is not convinced of its quality.

It gives the government sweeping powers to control even the radiation from a fluorescent lamp, or the thermostat in an electric iron! Under its provisions government agents would be able to force their way into any dwelling if the toaster sparked and the resulting wave train was detected! One of the hidden targets of the bill is undoubtedly receiver radiation, since the FCC has long been trying to get control over set manufacturers. This bill would give it to the Commission. At present the FCC has jurisdiction only over the generation of radio waves *intended* for transmission of intelligence and communications. Under the new bill junior's electric train operating by remote control would require to be licensed.

The bill appears to be unnecessary since under existing federal regulations any radio station can be ordered silent in time of emergency. There is much more danger from hidden, and *therefore unlicensed*, enemy agents' transmitters, for these could direct guided missiles to targets where the transmitters are hidden. Even the imposition of a hundred such bills would not affect these activities! The suggestion has been made that the blanket of oscillator and other radiation from receivers in a city might be sufficient to guide a missile to the city as a target. If this were indeed the case, switching off all the receivers would not be very effective since missiles guided by the infra red emanations could still find their way to such targets. If the bill should be passed it would strike at the basic freedom of Americans, and hasten the present trend towards state control, of which Great Britain, *with a similar control*, is such a sorry example.

TOTALLING 335 YEARS OF RADIO-TV

Eight old-timers among radio engineers, called together by H. V. Kaltenborn during a meeting of the Radio Pioneers at Toots Shor's, New York. Seated, beginning left: Dr. Alfred N. Goldsmith, consulting engineer and inventor of the RCA color-tube (who started in radio in 1901); Dr. Orestes H. Caldwell, editor of TELE-TECH (1904); Paul Godley, consulting engineer (1907); A. F. Van Dyck, RCA Laboratories (1908). Standing: Jack Poppele, chief engineer WOR and Teleradio, Inc. (1910); O. B. Hanson, engineering vice-president NBC (1912); Walter Evans, radio-TV vice-president Westinghouse (1911); Roy Harlow, BMI (started with Boston Marconi station in 1912)

New BIRTCHER TUBE CLAMP FOR MINIATURE TUBES

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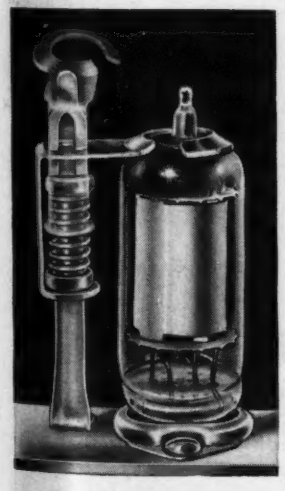

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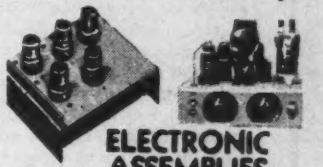

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IRE PROGRAM

(*Continued from page 74*)

bridge Research Laboratories.
"A Microwave Schmidt System"—H. N. Chait, Naval Research Laboratories, Washington 25, D. C.

Symposium: Nuclear Reactors

"Nuclear Energy Development and Military Technology"—A. M. Weinberg, Oak Ridge National Laboratory, Oak Ridge, Tenn.
"The Reactor as a Research Tool"—D. Hughes, Brookhaven National Laboratory, Upton, N. Y.
"Background Radiation Monitoring for Control of an Air-Cooled Pile"—F. P. Cowan, Brookhaven Radiation Laboratory, Upton, N. Y.
"Instrumentation in the Brookhaven Nuclear Reactor"—J. E. Binns, Brookhaven Radiation Laboratory, Upton, N. Y.

Television III: Receivers

"Synchroflection: A Horizontal Deflection SX System Possessing Inherent Noise Immunity"—K. R. Wendt and W. K. Squires, Sylvania Electric Products, Flushing, N. Y.
"Internal Television Receiver Interference"—B. Amos and W. Heiser, Allen B. Du Mont Laboratories, Inc., Passaic, N. J.
"An RF Amplifier for the UHF Television Bands"—B. F. Tyson and J. G. Weissman, Sylvania Electric Products.
"Television Line Selecto with Automatic Identifier"—J. Fisher, Philco Corp., Philadelphia, Pa.
"Development of a High-Stability UHF Television Tuner"—M. W. Slate, J. P. Van Duyne, and E. G. Mannerberg, Allen B. Du Mont Laboratories, Inc., Passaic, N. J.

Circuits V: Oscillators

"Oscillator Frequency Indeterminancy"—L. Riebman, Univ. of Pennsylvania.
"Simultaneous Oscillations in Oscillators"—H. Schaffner, Univ. of Illinois.
"Amplitude Stabilization of Oscillators by Nonlinear Networks"—L. Rosenthal, Rutgers Univ., New Brunswick, N. J.
"Stability of Oscillations in a Nonlinear System"—N. R. Scott
"Tuner Coupled Circuit for Oscillator Application"—R. A. Martin and R. D. Teasdale, Georgia Institute of Technology, Atlanta, Ga.

Symposium: Loudspeakers

"Amplitude and Phase Measurements on Loudspeaker Cones"—M. S. Corrington, Radio Corporation of America, Camden, N. J.
"Design Elements for Improved Bass Response in Loudspeaker Systems"—H. T. Souther, Electro-Voice, Inc., Buchanan, Mich.
"Direct-Radiator Loudspeaker Mounting"—H. F. Olson, Radio Corporation of America, Princeton, N. J.
"Physical and Electrical Constants of Direct Radiator Loudspeakers"—L. L. Beranek, Massachusetts Institute of Technology, Cambridge, Mass.

Microwaves V: Generators and Amplifiers

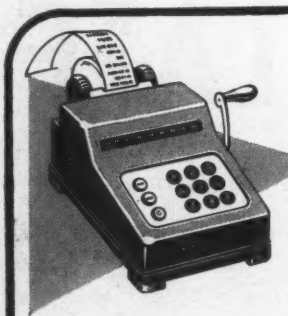
"Low-Distortion Frequency-Modulation Modulators"—A. R. Vallarino, Federal Telecommunication Laboratories, Nutley, N. J.
"1700- to 2400- Megacycle Triode Amplifier"—E. M. Ostlund and H. G. Miller, Federal Telecommunication Laboratories, Nutley, N. J.
"A K-Band Amplifier Klystron"—W. G. Abraham and J. W. Clark, Varian Associates, San Carlos, Calif.
"Mode Interactions in Magnetron Oscillators"—R. Moats, Sylvania Electric Products, Inc., Flushing, N. Y.
"Guiding Principles in the Production of Submillimeter Waves"—H. M. Van Foerster and H. Schaffner, Univ. of Illinois.

Symposium: Simulation as an Aid to Design of Remote Control Systems

"Simulation—Its Place in System Design"—H. H. Goode, Aeronautical Research Center, Ypsilanti, Mich.
"The Typhoon Simulator"—A. W. Vance, Radio Corporation of America, Princeton, N. J.
"The Application of the Simulator to the Design of Automatic Control Systems"—L. Botwin, Sperry Gyroscope Corp., Great Neck, N. Y.
"Real Time Simulation of Feedback Control Systems"—A. C. Hall, Bendix Aviation Corp., Detroit, Mich.
"Digital Computers in Simulated Control Systems"—J. W. Forrester, Massachusetts Institute of Technology, Cambridge, Mass.

Defense Communications and Signalling Equipment

The plans for raid warning equipment made, and laid away, in World War II are being brought up to date. In 1942 to 1945 the chance of air raids on this country was fairly remote, but today it is a distinct possibility. Therefore the makers of special receivers and attachments which will detect warning signals transmitted over the regular broadcast channels are growing increasingly busy. In fact the use of mobile radio equipment for point-to-point and general communications work is growing by leaps and bounds. While many details of receivers are restricted the principle of supersonic signals impressed on ordinary carriers to operate frequency sensitive relays is not new, in fact it is used daily in such harmless operations as Transitcasting and Storecasting. It is interesting to speculate as to whether the current crop of FM systems using supersonic signals is a development of the last emergency.



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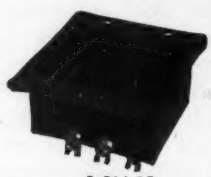

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James Millen Mfg. Co., Inc., 150 Exchange St., Malden, Mass.
Millivac Instruments, 111 Weaver St., Schenectady, N. Y.
Motorola, Inc., 1327 W. Washington Blvd., Chicago, Ill.
Mucon Corp., 9 St. Francis St., Newark 5, N. J.
Mycalex Corp. of America, 60 Clifton Blvd., Clifton, N. J.

National Carbon Co., Inc., 30 E. 42nd St., New York, N. Y.
National Co., Inc., 61 Sherman St., Malden, Mass.
National Research Corp., 70 Memorial Drive, Cambridge, Mass.
J. M. Ney Co., Hartford, Conn.
Northern Radio Co., 143 W. 22nd St., New York 11, N. Y.
N. R. K. Mfg. & Eng'g Co., 5644 N. Western Ave., Chicago 45, Ill.
Nuclear Instrument & Chemical Co., 223 West Erie St., Chicago 10, Ill.

Ohmite Mfg. Co., 4835 Flournoy St., Chicago 44, Ill.

Panoramic Radio Products, Inc., 10 S. 2nd Ave., Mt. Vernon, N. Y.
Par-Metal Products Corp., 32-62 49th St., Long Island City, N. Y.
Partridge Transformers Ltd., Roebuck Road, Tolworth, Surrey, England
Philco Corp., Tioga and C Sts., Philadelphia, Pa.
Polarad Electronics Co., 100 Metropolitan Ave., Brooklyn, N. Y.
Polytechnic Research & Devel. Co., 202 Tillary St., Brooklyn 1, N. Y.
Potter & Brumfield Mfg. Co., Inc., 107 N. 10th St., Princeton, Ind.
Potter Instrument Co., 115 Gutter Mill Rd., Great Neck, N. Y.
Precision Apparatus Corp., 92-27 Horace Harding Blvd., Elmhurst, L. I., N. Y.
Presto Recording Corp., Hackensack, N. J.
Price Electric Corp., E. Church and E. Second Sts., Frederick, Md.
Product Development Co., 526 Elm St., Arlington, N. J.
Pyramid Electric Co., 1445 Hudson Blvd., North Bergen, N. J.

Radio Corp. of America, Camden, N. J.
Radio Materials Corp., 1708 W. Belmont St., Chicago, Ill.
Radio Receptor Co., Inc., 251 W. 19th St., New York, N. Y.
Rahm Instruments, Inc., 12 W. Broadway, New York, N. Y.
Rangertone, Inc., 73 Winthrop St., Newark 4, N. J.
Rauland Corp., 4245 N. Knox Ave., Chicago 41, Ill.
Raytheon Mfg. Co., 55 Chapel St., Newton, Mass.
Reeves Instrument Corp., 215 E. 91st St., New York, N. Y.
Reeves Soundcraft, Inc., 10 E. 52nd St., New York, N. Y.
John F. Rider Publisher, Inc., 480 Canal St., New York, N. Y.
Robinson Aviation, Inc., Teterboro Air Terminal, Teterboro, N. J.
Rotron Mfg. Co., 190 Weeden St., Pawtucket, R. I.

Sanborn Co., 39 Osborn St., Cambridge 39, Mass.
Carl W. Schutter, Rockville Centre, L. I., N. Y.
Scientific Electric, 111 Monroe St., Garfield, N. J.
Herman Hosmer Scott, Inc., 385 Putnam Ave., Cambridge, Mass.
Servo Corp. of America, New Hyde Park, N. Y.
Shallcross Mfg. Co., 10 Jackson Ave., Collingdale, Pa.
Sheldon Electric Co., 68-98 Coit St., Irvington, N. J.
Sigma Instruments, Inc., 70 Ceylon St., Boston 20, Mass.
Simpson Electric Co., 5216 Kinzie St., Chicago 14, Ill.
Mark Simpson Mfg. Co., 32-17 49th St., Long Island City, N. Y.
Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.
Sorenson & Co., Inc., P. O. Box 1215, Stamford, Conn.
Specialties, Inc., Skunks Misery Rd., Syosset, L. I., N. Y.
Spencer-Kennedy Laboratories, 186 Massachusetts Ave., Cambridge, Mass.
Sperry Gyroscope Div., Sperry Corp., Great Neck, L. I., N. Y.
Sprague Electric Co., North Adams, Mass.
Square Root Mfg. Corp., 391 Sawmill River Rd., Yonkers 6, N. Y.
Standard Electric Time Co., 89 Logan St., Springfield 2, Mass.
Standard Piezo Co., P. O. Box 164, Carlisle, Pa.
Standard Transformer Corp., 3580 Elston Ave., Chicago, Ill.
Stephens Mfg. Co., 8538 Warner Drive, Culver City, Calif.
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Technology Instrument Corp., 1058 Main St., Waltham, Mass.
Tektronix, Inc., 712 S. Hawthorne Blvd., Portland 14, Ore.
Telechron Corp., 75 Homer Ave., Ashland, Mass.
Television Equipment Corp., 238 William St., New York, N. Y.
Tel-Instrument Co., Inc., 50 Patterson Ave., East Rutherford, N. J.
Terminal Radio Corp. 85 Cortlandt St., New York, N. Y.
L. H. Terpening, Corp., 16 W. 61st St., New York, N. Y.
Thomas Electronics, Inc., 118 Ninth St., Passaic, N. J.
Tinnerman Products, Inc., 2038 Fulton Rd., Cleveland 13, Ohio
Titeflex, Inc., 500 Frelinghuysen Ave., Newark 5, N. J.
Transicoil Corp., 114 Worth St., New York 13, N. Y.
Triplett Electrical Instrument Co., 122 Main St., Bluffton, Ohio
Truscon Steel Co., Youngstown, Ohio

U. S. Armed Forces Washington, D. C.
United Transformer Corp., 150 Varick St., New York 13, N. Y.
Universal Winding Co., 1655 Elmwood Ave., Providence, R. I.
University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y.

Vacuum Electronic Engineering Co., 316 37th St., Brooklyn 32, N. Y.
Varian Associates 98 Washington St., San Carlos, Calif.
Vector Electronic Co., 1101 Riverside Drive, Los Angeles 31, Calif.
Victoreen Instrument Co., 3800 Perkins Ave., Cleveland 14, Ohio
Vitramon, Inc., Stepney, Conn.

Waldes Koh-I-Noor, Inc., 47-10 Austel Place, Long Island City 1, N. Y.
Ward Leonard Electric Co., 115 McQuesten Parkway, Mt. Vernon, N. Y.
Ward Products Corp., 1523 E. 45th St., Cleveland, Ohio
Waterman Prods. Co., 2445 Emerald St., Philadelphia 25, Pa.
Webster-Chicago Corp., 5626 Bloomingdale Ave., Chicago 39, Ill.
Western Lithograph Co., 600 E. Second St., Los Angeles 54, Calif.
Westinghouse Electric Corp., East Pittsburgh, Pa.
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